Distinguishing Velvet, White-winged and Stejneger's Scoter in female-type plumage based on bill feathering

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Over the past few decades, considerable attention has been devoted to differentiating between two North American and East Asian scoter species, namely White-winged Scoter *Melanitta deglandi* (hereafter *deglandi*) and Stejneger's Scoter *M stejnegeri* (hereafter *stejnegeri*), especially in the context of their occurrence as vagrants in Europe. Records of these species in Europe have seen a significant surge, leading to a considerable increase in the likelihood of encountering them among the regular Velvet Scoters *M fusca* (hereafter *fusca*; Garner et al 2004, Collinson et al 2006, Gibbins et al 2015, Könönen 2021). The presumed hybridisation of both taxa with Velvet (Komisja Faunistyczna 2019, 2020, Malmhagen 2021, Strack 2021, Stronach 2021, Huhtinen et al 2022, 2023, López-Velasco et al 2025) has added complexity. Previous literature on *deglandi* and *stejnegeri* has primarily focused on the separation of adult males. In this paper, we focus on adult females and young birds in female-type plumage which, so far, have been considered so similar that the marginal structural differences were deemed to have little value, particularly for field identification (Collinson et al 2006, Pyle 2008).

In more recent literature on scoter taxa identification, the female-plumaged *deglandi* and *stejnegeri* have been differentiated from *fusca* by head shape and head and bill profile, with additional emphasis on bill-side feathering (Garner et al 2004, Garner 2008, 2014, Reeber 2015). *Stejnegeri* female is described as having a distinctive head shape, with the profile of the front of the head and the bill culmen forming a nearly straight line from forehead to bill tip. On the other hand, *deglandi*'s profile shows a different shape, with the prominent base part of the bill above the nostril typically displaying a distinct swollen central culmen. Additionally, the white patches in the plumage in front of the eye and on the ear-coverts are reported to be clearer and sharper in *deglandi* than in *stejnegeri*.

Small differences in bill base feathering have also been suggested between *deglandi* and *stejnegeri* but these have been described unclearly and inconsistently. For instance, bill-side feathering is said to be similar in both *deglandi* and *stejnegeri*, while the distinction from *fusca* is noted to be pronounced (Garner et al 2004, Garner 2008, 2014). However, Reeber (2015) describes *deglandi*'s bill-base feathering as forming a right angle and *stejnegeri*'s to some extent a sharp angle. The feathering on the culmen of *deglandi* is described as extending slightly further, even to the rear edge of the nostril, while on *stejnegeri*, the feathering is said to remain closer to the base of the bill (Garner 2008, 2014).

Material and methods

In this study, we systematically photographed the bill shapes of *deglandi*, *fusca* and *stejnegeri*, along with the extension of feathering on the bill-side and culmen, using specimens from various museums: Natural History Museum, Tring, England (NHMUK); Danish Natural History Museum, København, Denmark (NHMD); Finnish Museum of Natural History, Helsinki, Finland (FNHM); and Zoological Museum, Turku, Finland (ZMT). Specimens were selected based on their collection locations within the core breeding distribution areas of each taxon, thereby minimising the likelihood of misidentification. The samples examined comprised: *deglandi* (16 specimens), *fusca* (28) and *stejnegeri* (15). Each specimen was positioned individually on a table to ensure photographs were taken as perpendicularly as possible to the subject, as illustrated in figure 1 and 4.

Measurements were subsequently performed using the ImageJ image processing software. To ensure relevance and adaptability, we calculated ratios of the measured parameters, eliminating the need for absolute values. This approach is pivotal in developing identification criteria applicable to photographed individuals, where absolute dimensions cannot be directly obtained. The study focused on juvenile-plumaged birds of both sexes during their first autumn and winter, as well as females older than this. First-winter males and second calendar-year spring birds that had begun developing adult male characteristics were ex-

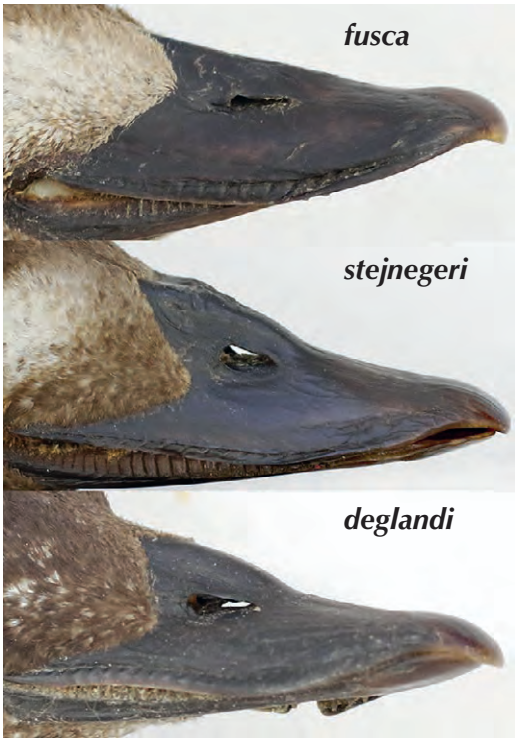

FIGURE 1 Examples of female-type Velvet Scoter / Grote Zee-eend *Melanitta fusca*, Stejneger's Scoter / Aziatische Grote Zee-eend *M stejnegeri* and White-winged Scoter / Amerikaanse Grote Zee-eend *M deglandi*, Natural History Museum, Tring, England, 11 January 2024 *(Hannu Huhtinen/©NHMUK)*

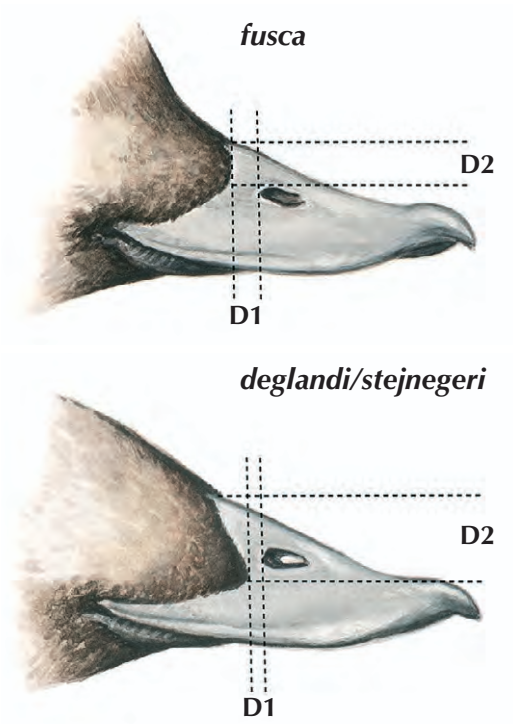

FIGURE 2 Schematic representation of relative extension of bill feathering compared with nostril opening in Velvet Scoter / Grote Zee-eend *Melanitta fusca* and White-winged/Stejneger's Scoter / Amerikaanse/Aziatische Grote Zee-eend *M deglandi/stejnegeri (Juho Könönen)*. Parameter D1 describes horizontal distance from tip of feathering on bill-side to rear of nostril. Similarly, parameter D2 describes vertical distance from bill-tip feathering to height of bill culmen.

cluded from the analysis. Based on the data, we established a set of criteria for distinguishing female-type plumaged *fusca* from *deglandi* and *stejnegeri*, and for differentiating *deglandi* from *stejnegeri* using bill characteristics. These criteria have been designed to leverage the extensive photographic material available for scoter taxa, offering a quantitative method for the reliable identification of female-type individuals.

Separation of *fusca* from both *deglandi* and *stejnegeri*

The most distinct difference in bill shape between *fusca* and both *deglandi* and *stejnegeri* is that *fusca* typically exhibits a straight profile along the culmen, lacking the distinctive swelling observed in both *stejnegeri* and particularly *deglandi* (figure 1). However, not all *deglandi* and *stejnegeri* specimens exhibit a distinct knob on the bill culmen (eg, the *stejnegeri* in figure 4) rendering this characteristic insufficient for species-level identification. Another noticeable distinction is found in the feathering on the bill-side. At the base of the bill, starting from the cutting edge, the feathering on *fusca* rises sharply, often at an angle exceeding 45° towards the culmen. Consequently, the front tip of the bill-side feathering is positioned relatively high, typically even above the nostril, and its tip falls far behind the nostril. Conversely, in both *deglandi* and *stejnegeri*, the bill-side feathering rises at a shallower angle, with the tip falling well below that of *fusca*, typically beneath the lower edge of the nostril. Additionally, the tip of the feathering in both *deglandi* and *stejnegeri* extends further, approaching the nostril more closely than in *fusca*.

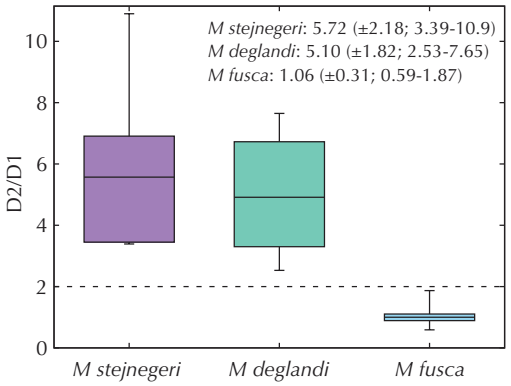

FIGURE 3 Differences between Velvet Scoter / Grote Zeeeend *Melanitta fusca* (n=28), White-winged Scoter / Amerikaanse Grote Zee-eend *M deglandi* (n=16) and Stejneger's Scoter / Aziatische Grote Zee-eend *M stejnegeri* (n=15), based on ratio of parameter D2 and D1 measured from bill feathering, as explained in figure 2. Boxes represent quartiles of D2/D1 ratio on both sides of median and whiskers depict extreme values of parameter. In inset, mean value of parameter D2/D1 is given, with values in parentheses illustrating observed standard deviation and range.

Distinguishing *fusca* from both *deglandi* and *stejnegeri* can be accomplished by measuring the distance of the bill-side feathering from the nostril opening, ensuring the nostril is oriented as horizontally as possible. This distance can be estimated from photographs, allowing the application of the criterion without precise measurements. By measuring the length from the tip of the feathering on the bill-side to the rear of the nostril (D1) and the distance from the height of the tip of the feathering to the height of the culmen (D2), the ratio of these lengths (D2/D1) provides a reliable means of differentiation. Figure 2 illustrates the determination of parameters D1 and D2 from bill feathering, while figure 3 highlights the distinctions in relation to D2/D1. In summary, a D2/D1 ratio higher than 2 indicates that the bird is either *deglandi* or *stejnegeri*. Conversely, if the D2/D1 ratio is lower than 2, the data clearly show that the bird is *fusca*.

Separation of *deglandi* from *stejnegeri*

The shape of the bill, especially in males, undergoes significant changes in *stejnegeri* during the first two years of life, making it difficult to provide an unambiguous description of the differences, particularly when compared with *deglandi*. As can be seen in figure 4, the only distinct feature observable in the skin specimens is the relatively straight bill culmen extending from the base feathering to the base of the bill's nail. Among the specimens, only two *stejnegeri* seem to exhibit a noticeable swelling on the culmen above the nostril, a characteristic typical of *deglandi*. In *deglandi*, the shape of the bill displays considerable variation, too, but shows a noticeable swelling over the culmen above the nostril compared with *stejne-*

FIGURE 4 Examples depicting bill structure and feathering of White-winged Scoter / Amerikaanse Grote Zee-eend *Melanitta deglandi* and Stejneger's Scoter / Aziatische Grote Zee-eend *M stejnegeri* based on museum skins, Natural History Museum, Tring, England, 11 January 2024 *(Hannu Huhtinen/©NHMUK)*

geri (see also Lazaro 2020). Nonetheless, even within this material, a few *deglandi* exhibit a relatively straight culmen, closely resembling *stejnegeri*. Therefore, the shape of the bill can be regarded as secondary identification characteristic between *deglandi* and *stejnegeri*.

Typically, in *stejnegeri*, the feathering on the bill-side ascends from the base, along the cutting edge, at a relatively steep angle toward the centre of the nostril. From there, the feathering curves back towards the base of the culmen, creating an almost straight angle with the front of the feathering. Consequently, when viewed from the side, the upper part of the feathering in *stejnegeri* curves more steeply towards the base of the culmen, making the leading edge of the feathering less vertical compared with that in *deglandi*. In *deglandi*, the feathering on the bill-side ascends from the base of the bill at the cutting edge with a slightly more gradual incline compared with *stejnegeri*, typically angling towards the front of the nostril. When viewed from the front, the feathering curves more gently towards the culmen in *deglandi* than in *stejnegeri*, resulting in the front edge of the feathering appearing more vertical. Given this, the bill-side feathering can be deemed a reliable supporting characteristic when distinguishing *deglandi* from *stejnegeri*.

On the culmen, when seen from above, the tip of the feathering in *stejnegeri* has a rounded shape towards the tip of the bill and remains far away from the tip of the side feathering on the bill (figure 4). Additionally, the distance from the tip of the feathering on the culmen to the rear edge of the nostril is at least equal to the horizontal length of the nostril. Sometimes, the feathering on the culmen may be restricted to a relatively straight line across the culmen. In *deglandi*, the feathering on the culmen creates a distinct angle that extends towards and often beyond the rear end of the nostril. Consequently, the feathering on the culmen reaches the same level or even surpasses the feathering on the bill-side, a feature that differentiates *deglandi* from *stejnegeri*. Hence, we can infer that the shape of the feathering, particularly its extension along the culmen can be considered a good distinguishing characteristic between *deglandi* and *stejnegeri*.

Based on the distinctions outlined above, we can establish a quantitative criterion for differentiating *deglandi* and *stejnegeri*. *Deglandi* and *stejnegeri* can be easily differentiated by examining the relative extension of the feathering on the bill-side and its culmen concerning the rear edge of the nostril. This distinction can be achieved through the analysis of good photographs using image processing software, eliminating the need for absolute measurement data. Specifically, a photograph enables the measurement of the distance from the tip of the feathering on the bill-side to the rear edge of the nostril (D1) and the distance from the tip of the feathering at the culmen of the bill to the rear edge of the nostril (D3). The ratio of these lengths, D3/D1, serves as a reliable indicator for identification. Figure 5 illustrates the determination of parameters D1 and D3 from the bill and figure 6 depicts the difference in the D3/D1 ratio between *deglandi* and *stejnegeri*. In summary, the clear difference between *deglandi* and *stejnegeri* can be found in parameter D3. If the D3/D1 ratio is higher than 2, the identification can be confidently assigned to *stejnegeri*. Conversely, a D3/D1 value lower than 2 indicates *deglandi*. Notably, in *deglandi*, the tip of the feathering on the culmen is typically positioned very close to the rear edge of the nostril, which can result in negative D3 values when the tip of the feathering on the culmen extends beyond the rear edge of the nostril. Consequently, the D3/D1 ratio can also yield negative values for *deglandi*, as shown in figure 6. The bill characters of *deglandi* and *stejnegeri* are summarised in table 1.

Application notes for photo-documented field records

From high-quality photographs, distinguishing fe-

TABLE 1 Summary of bill characteristics based on museum skin specimens in White-winged Scoter *Melanitta deglandi* and Stejneger's Scoter *M stejnegeri*

Characteristic	***deglandi***	***stejnegeri***
profile of bill culmen	prominent swelling on culmen above nostril	straight culmen extending from bill-base to nail
shape of feathering on bill-side	leading edge of feathering nearly vertical	pronounced angle extending from tip of feathering to base of culmen
shape of feathering on culmen	tip of feathering sharp, extending to tip of feathering on bill-side	tip of feathering rounded, extending far behind tip of feathering on bill-side

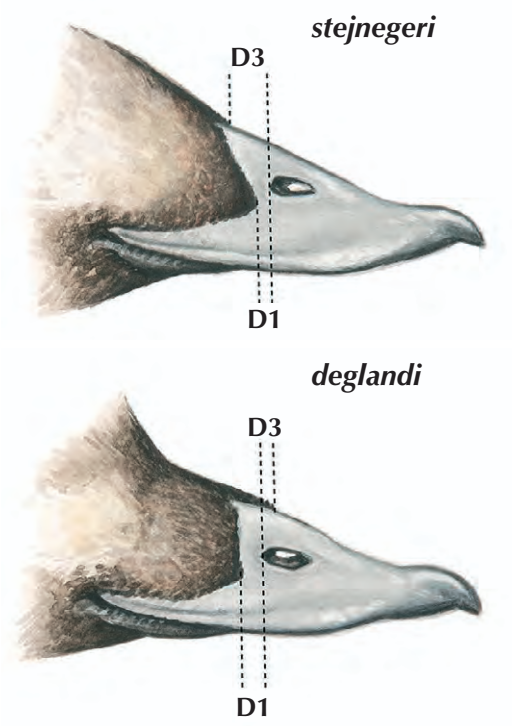

FIGURE 5 Schematic representation of relative extension of bill feathering compared with nostril opening of Stejneger's Scoter / Aziatische Grote Zee-eend *Melanitta stejnegeri* and White-winged Scoter / Amerikaanse Grote Zee-eend *Melanitta deglandi (Juho Könönen)*. Parameter D1 describes distance from tip of feathering on bill-side to rear of nostril (same as in figure 2). Similarly, parameter D3 describes distance of tip of feathering at culmen from rear of nostril. These quantities can be easily measured, for example, from high-quality photographs using image processing program, and ratio of parameter D3 to D1 reliably indicates whether female-plumaged bird is *deglandi* or *stejnegeri*.

male-type *fusca* from both *deglandi* and *stejnegeri* is typically straightforward, often achievable even from flight photographs taken at considerable distances. In such cases, apart from the profile of the bill culmen, the most conspicuous difference lies in the angle at which the bill-side feathering rises from the base of the bill's cutting edge towards the upper part of the nostril, while remaining notably distant from it. Conversely, in both *deglandi* and *stejnegeri*, the feathering ascends much more gradually on the bill-side, with the tip of the feathering extending well below the nostril in a vertical direction, albeit reaching further towards the rear edge of the nostril compared with *fusca*. When

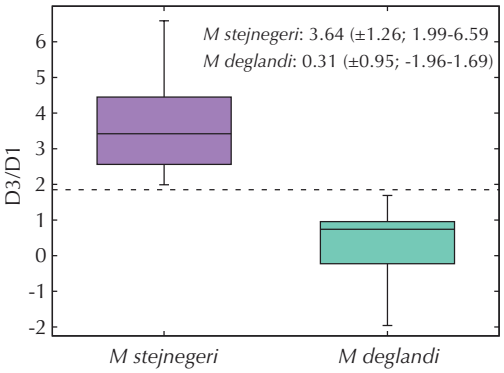

FIGURE 6 Difference between White-winged Scoter / Amerikaanse Grote Zee-eend *Melanitta deglandi* (n=16) and Stejneger's Scoter / Aziatische Grote Zee-eend *M stejnegeri* (n=15) by ratio of parameter D1 and D3 measured from bill feathering, as described in figure 5. Boxes represent quartiles of D3/D1 ratio on both sides of median and whiskers depict extreme values of parameter. In inset, mean value of parameter D3/D1 is given, with values in parentheses illustrating observed standard deviation and range.

measuring parameter D1 and D2, it is crucial to consider the angle at which the bill is oriented both vertically and horizontally towards the viewer of the photograph, as this can significantly influence measurement errors in D1 and D2.

Differentiating between *deglandi and stejnegeri* from photographs is often more challenging compared with *fusca* and necessitates a thorough understanding of how accurately the tip of the feathering on the bill culmen can be assessed from images. Discerning the precise extension of the sharp tip of the culmen feathering, particularly in *deglandi*, is nearly impossible in many instances from a side-profile image. While in museum specimens it has always been feasible to directly ascertain the extension of the feathering tip from an image taken from above the bill, field photographs may capture the bill at a side angle, causing the tip of the culmen feathering to be obscured within a small hollow on the culmen. Consequently, if the bill's position in the photograph makes it challenging to reliably estimate the position of the feathering tip on the culmen, the criterion based on the quotient of parameter D1 and D3 cannot be used for identification purposes. In practice, this means that if the culmen profile and shape of the bill-side feathering fail to provide sufficiently convincing evidence to differentiate between *deglandi* and *stejnegeri*, then the identification must be designated as the species pair *deglandi/stejnegeri*.




28 Velvet Scoter / Grote Zee-eend *Melanitta fusca*, female, Valkenburgse Meer, Zuid-Holland, Netherlands, 18 December 2013 *(René van Rossum)* **29** White-winged Scoter / Amerikaanse Grote Zee-eend *Melanitta deglandi*, first-winter female, Massachusetts, USA, November 2016 *(Guillermo Rodríguez Lázaro)* **30** Stejneger's Scoter / Aziatische Grote Zee-eend *Melanitta stejnegeri*, juvenile, Ulleung, South Korea, 21 November 2013 *(Nial Moores)* **31** Stejneger's Scoter / Aziatische Grote Zee-eend *Melanitta stejnegeri*, female or immature male, Övörhangay, Mongolia, 19 July 2019 *(Oscar Campbell)*

It is worth noting that as male hybrids have been observed among the three taxa (see references above), it is reasonable to assume that female hybrids also exist. However, since the distinctions between *deglandi*, *fusca* and *stejnegeri* in female-type birds, as outlined in this paper, are relatively minor, it is not feasible to identify or consider potential hybrids using these criteria.

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Samenvatting
Onderscheid van Grote, Amerikaanse Grote en Aziatische Grote Zee-eend in vrouwtjes-type kleed op basis van snavelbevedering De herkenning van vrouwtjes-type Grote *Melanitta fusca*, Amerikaanse Grote *M deglandi* en Aziatische Grote Zee-eend *M stejnegeri* is door de subtiele morfologische verschillen een uitdagende opgave. Eerdere studies richtten zich op het onderscheiden van mannetjes maar in dit artikel worden enkele minder in het oog springende kenmerken van juvenielen en vrouwtjes nader onderzocht, met de focus op de vorm en uitbreiding van de snavelbevedering. Aan de hand van museumbalgen afkomstig uit het hart van de broed-

32 Velvet Scoter / Grote Zee-eend *Melanitta fusca*, female, Brouwersdam, Zeeland, Netherlands, 30 December 2014 *(Kris De Rouck)*

33 White-winged Scoter / Amerikaanse Grote Zee-eend *Melanitta deglandi*, female, Stewart Park, Tompkins, New York, USA, 21 October 2017 *(Jay McGowan)*

gebieden worden kwantitatieve criteria vastgesteld gebaseerd op de bevedering op het culmen en de zijkant van de snavel. Deze criteria, uitgedrukt als ratio's van aan de balgen genomen maten, maken het mogelijk een taxon te herkennen zonder de absolute afmetingen te kennen, waardoor de methode toepasbaar is op foto's van vogels in het veld.

De studie toont aan dat *fusca* betrouwbaar kan worden onderscheiden van *deglandi* en *stejnegeri* op basis van de hoek en positie van de bevedering op de snavelzijde. Het onderscheiden van *deglandi* van *stejnegeri* is subtieler, gebaseerd op variaties in culmenprofiel en mate van uitbreiding van de bevedering. De methode verhoogt de nauwkeurigheid van de identificatie maar er blijven beperkingen in geval van hybriden of bij overlappende kenmerken. Niettemin geeft deze studie een praktische leidraad voor de herkenning van vrouwtjestype zee-eenden die kan bijdragen aan een betere kennis over deze nauwverwante taxa.

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