

# SOCIAL AND SEXUAL BEHAVIOR OF INTERSEX MALLARDS: A LITERATURE REVIEW AND A NEW CASE STUDY

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**ABSTRACT:** Spontaneous sex reversal is a form of intersexuality in which one sex, usually a female, acquires traits of the other sex. We reviewed previously published accounts of intersex Mallards (*Anas platyrhynchos*) resulting from sex reversal, of which four individuals behaved as females and four behaved as males, and two of the latter mounted other females. Video analyses of an intersex Mallard in Napa, Napa County, California, revealed that it was less social, spending much more time alone than either sex of normal Mallards during the breeding season, and behaved like a female by spending much more time with males than with females. It is unknown why some intersex Mallards behave as females and others as males.

Intersexuality, the mixing of male and female traits in an individual (Armstrong and Marshall 1964), has been known in birds since antiquity, beginning with a description by Aristotle (384–322 BC) of female chickens acquiring male traits (Cresswell 1887, Forbes 1947). Sex in birds is genetically determined by sex chromosomes, males being homogametic (ZZ), females heterogametic (ZW). But sex differences in morphology and behavior are also strongly influenced by hormonal factors; perturbations of either genetic or hormonal factors may result in intersexuality (see reviews by Taber 1964, Owens and Short 1995, Clinton and Haines 1999, Birkhead 2008, Major and Smith 2016, Zhang et al. 2023). In birds, spontaneous sex reversal is the most common of several forms of intersexuality, occurring when one sex, almost always a female, acquires traits of the other sex. In female birds, only the left ovary is functional; if it ceases to function (usually because of disease) and fails to produce estrogen, the right gonad becomes masculinized and male traits develop in many but not all species (Taber 1964, Owens and Short 1995, Clinton and Haines 1999, Birkhead 2008, Major and Smith 2016, Zhang et al. 2023).

Spontaneous sex reversal is easiest to detect in sexually dimorphic species of birds, including the Mallard (*Anas platyrhynchos*). Changes in the plumage, gonads, or behavior of masculinized female (i.e., intersex) Mallards have been reported anecdotally by various authors (Home 1799, Nilsson 1845, Korschelt 1887, 1888, Tichomiroff 1888, Brandt 1889, Willey 1892, Lonnberg 1926, Kuroda 1960, Post and Kompanje 1992, Lehmus 2011, Sjögren and Waldenström 2021). Goodale (1910) and Caridroit (1938) experimentally demonstrated that ovariectomized female Mallards acquire male basic plumage (Pyle 2005), but the plumage of castrated males does not change.

Although Brandt (1889) reviewed earlier reports of intersexuality in the Mallard, no comprehensive reviews have appeared in the literature subsequently. In this study we review the literature on the social and sexual behavior of intersex Mallards resulting from sex reversal and provide quantitative data from a new case study.

## METHODS

### Literature Review

We initially used Google and Google Scholar to search for pertinent literature, using a variety of terms including “*Anas*,” “duck,” “intersex,” and “sex reversal.” Citations within these articles yielded additional references. We used Google Translate to assist with translation of five non-English languages into English.

### New Case Study

We first encountered an intersex Mallard of unknown age in a pond at John F. Kennedy Park, Napa, Napa County, California (38° 16' 11" N, 122° 16' 49" W), on 31 March 2020, and it remained resident through April 2023. The duck was identified as an intersex Mallard by its mostly black bill (typical of a female; bill entirely yellow except for the nail in a male), partially green head (never green in a female, but entirely green in a basic-plumaged male), and curly tail feathers (never curly in a female, but always curly in a male) (Figure 1). To quantitatively assess whether the intersex Mallard behaved more like a male or a female, we used cell phone and small point-and-shoot cameras to obtain 144.1 min of video of the intersex Mallard and 209.4 min of normal male and female Mallards in clear weather during the nonbreeding season on 30 January 2022 and during the breeding season on 15 and 20



FIGURE 1. An intersex Mallard (*Anas platyrhynchos*), presumably resulting from a female acquiring male traits after its ovary ceased to function, at John F. Kennedy Park in Napa, Napa County, California, 21 February 2021.

Photo by Floyd E. Hayes

April 2021, 20 March 2022, and 11 April 2022. Because the Mallards were unmarked, we do not know the number of individuals examined in our videos, although we counted the number of adults of each sex present and calculated the sex ratio during the 2022 visits.

We subsequently analyzed the videos and recorded the number of seconds the intersex Mallard was less than or greater than two body lengths from the nearest Mallard, whose sex was identified. Similarly, we recorded this information from normal Mallards, also identifying their sex. We used these data to compare the social behavior of the intersex Mallard with that of normal male and female Mallards. Because the data represented a time series and lacked independence, we did not test them statistically.

## RESULTS

### Literature Review

The first account of an intersex Mallard was published by Home (1799), who described a female duck in England that hatched in 1781 and laid eggs until 1789 (8 years old), when “curled feathers, peculiar to the drake, made their appearance in the tail” (indicating the bird was a Mallard). It quit laying and “frequently attempted to tread [mount] the other ducks, both in the water, and upon the ground; and they courted her in return,” indicating it behaved as a male, until 19 August 1791, when “she trod [mounted] a duck in the water” and “never afterwards suffered a drake to come near her” (p. 174).

From Scandinavia, Nilsson (1845) described a female duck that began to acquire “the costume of the male” (p. 404, translated from German) when 7 years old and fully acquired male plumage at the age of 10 years. The species was not identified and the bird’s behavior was not described. This account was briefly mentioned by Darwin (1868).

From Germany, Korschelt (1887, 1888) described a female duck that hatched in 1871 and laid eggs until 1883 (12 years old). At the age of 13 years it began acquiring male plumage, including “curved feathers located on the tail” (Korschelt 1888:111, translated from French), and then died when 16 years old. The duck “took on the habits of a male, which she had never shown before. She was looking to do the copulatory act on the females with whom she lived in company, and behaved in this quite like a real male” (Korschelt 1888:111, translated from French).

After discussing the previous case, Brandt (1889) stated that an intersex Mallard of unknown age in Russia, described by “Tichomirow,” exhibited “the opposite behavior, since, according to the breeder, the duck avoided the males,” indicating that it behaved as a male, “but did not step on [mount] other ducks” (p. 112, translated from German). This description presumably refers to Tichomirow (1888), who described the gonads of an intersex Mallard but did not describe its behavior.

From Germany, Willey (1892) described an intersex Mallard of unknown age that laid eggs for several years and then stopped laying eggs for 2 years, “although an opportunity to mate was given” (p. 60, translated from German).

Goodale (1910) experimentally removed the ovary of female Mallards and

afterward stated “All that can be said in regard to sexual behavior is that the castrated females seem quieter than the others” (p. 47).

Lonnberg (1926) described two intersex Mallards of unknown age in Sweden. The first became “inseparable friends” with a drake, indicating that it behaved as a female, although “no approach on the part of the male was observed.” But the following year “a change in the drakes’ behavior” occurred when “the pair was attacked by all the pond’s drake Mallards. It soon became clear to me that the attack concerned the female in an act intended to kill her” (p. 176, translated from Swedish), suggesting that the intersex Mallard was treated as a female and gang raped by male Mallards. The second intersex female “lived alone for two years and was not persecuted by the others” (p. 178, translated from Swedish).

Hart (1936) described the genitalia of an intersex Indian Runner (breed of domesticated Mallard) whose tail feathers became curly in Australia, but did not describe its behavior.

Kuroda (1960) described four intersex Mallards of unknown age in Japan. The second “behaved like a male and lived as the number one with other female Mallards, but did not mate.” The behavior of the third was “always the same as that of the female” (p. 277, translated from Japanese).

From the Netherlands, Post and Kompanje (1992) described an intersex Mallard that acquired male traits after its 10th year but “still behaved as a female and was treated as such by the other ducks. Just as before she participated in pairings with those in the group of males” (p. 131, translated from Dutch) until she died during her 14th year.

Lehmus (2011) provided photos of two intersex Mallards of unknown age and pointed out their similarity to hybrids with the Gadwall (*Mareca strepera*), but did not describe their behavior.

Sjögren and Waldenström (2021) described plumage changes in an intersex Mallard of unknown age in Sweden over 6 years. It “usually rested together with male Mallards. Even in summer, when it was seen by the river, it was accompanied by males” (p. 71, translated from Swedish), indicating it behaved as a female.

### New Case Study

In January 2022, the intersex Mallard at our study site was one of 88 Mallards among which the ratio of males to females was 1.26. During the breeding season (March–April) this ratio ranged from 2.6 ( $n = 43$ ) on 20 March to 3.6 ( $n = 69$ ) on 11 April 2022.

During the breeding season, the intersex Mallard was less social, spending much more time alone, than either sex of normal Mallards, but during the nonbreeding season it was just as social as normal Mallards, perhaps even more so (Table 1). Normal female Mallards associated much more frequently with males than with other females, and normal male Mallards associated much more frequently with females than with other males, especially during the breeding season (Table 1). The intersex Mallard associated more frequently with females than with males during the nonbreeding season but much more frequently with males than with females during the breeding season (Table 1).

We observed seven incidents of physical contact between normal Mal-

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**TABLE 1** Time an Intersex Mallard, Normal Female Mallards, and Normal Male Mallards Spent Alone or within Two Body Lengths of Other Mallards at Napa, California

Type of association	January		March		April	
	%	sec	%	sec	%	sec
Normal female Mallards						
Alone	24.0	729	9.5	246	3.9	175
with ♀	6.2	187	0	0	7.3	328
with ♂	69.8	2118	90.5	2330	88.8	4006
Normal male Mallards						
Alone	27.9	892	9.4	246	7.9	404
with ♀	66.2	2118	89.1	2330	78.8	4006
with ♂	5.9	188	1.5	38	13.3	676
Intersex Mallard						
Alone	18.0	616	24.7	108	28.0	1340
with ♀	48.5	1659	0	0	11.4	547
with ♂	33.5	1146	75.3	329	60.6	2901

lards, all during the breeding season. The four most aggressive incidents were instigated by males, including two males fighting head-to-head, a male chasing a male–female pair and biting the male, a male biting a female on its back, and several males taking turns raping a female. Two incidents were instigated by females, whose bills briefly bumped the side and rear end, respectively, of males beside them. One incident occurred when the rear ends of a male and a female bumped incidentally as they were feeding. We never observed a physical encounter between the intersex Mallard and another Mallard.

DISCUSSION

Intersex Mallards are quite rare, occurring at a very low and unknown frequency. Although the male-biased sex ratio in our population is typical of the Mallard (Alisauskas et al. 2014), the apparently increased proportion of males during the breeding season was likely due to hidden females incubating eggs in nests in nearby vegetation (chicks were present during March and April). In the congeneric Northern Pintail (*Anas acuta*), intersex individuals represent 0.01–0.18% of the population (Chiba and Honma 2011). Studies attempting to quantify the proportion of intersex Mallards in the general population should do so prior to the nesting season, when nesting females are less likely to be hidden in vegetation.

During the breeding season, the intersex Mallard that we observed was less social than normal Mallards of either sex. Lonnberg’s (1926) second intersex Mallard “lived alone for two years,” suggesting that it, too, was less social than other Mallards. It is unknown how the degree of sociability varies among intersex Mallards.

During focal observations, the intersex Mallard associated much more frequently with males than with females, a behavior more characteristic of females than of males. And our intersex Mallard did not engage in physical

contact with other Mallards, which is more consistent with female Mallards in both our study and other studies (Drilling et al. 2020).

Although our intersex Mallard clearly behaved and was treated by other Mallards as a female, previously published anecdotal accounts reveal that intersex Mallards vary greatly in their social and sexual behavior. In the literature we reviewed, four behaved as females and one of these was apparently gang-raped by males (Lonnberg 1926, Kuroda 1960, Post and Kompanje 1992, Sjögren and Waldenström 2021). Four behaved as males and two of these mounted females (Home 1799, Korschelt 1887, 1888, Brandt 1889, Kuroda 1960). In the Northern Pintail, intersex individuals occasionally engage in male-like courtship behavior, but they have not been reported mounting females (Chiba and Honma 2011). Intersex domestic chickens have been reported mounting females (Taber 1964).

It is unknown why some intersex Mallards behave as females and others as males. Obviously much remains to be learned about the social and sexual behavior of intersex Mallards. Our method of quantifying the amount of time an intersex Mallard associates with males or females is a novel approach and could be used in future studies to assess whether such individuals behave as males or females.

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