ON SEX DIMORPHISM IN THE JACKDAW (*CORVUS MONEDULA*)

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Introduction

It seems to be a common belief that there are no differences in colour between the sexes of the Jackdaw. So far as known, in the ornithological handbooks, the description of the species always refers to both sexes equally as regards colour. The Jackdaw is a typical member of the genus *Corvus* within which the plumage usually is either black, or black and grey, the grey areas being rather dark. Because of the intensity of pigment saturation, the colour variation is generally rather restricted. This appears particularly true in those cases of sexual dimorphism in which one of the sexes is uniformly black or very dark while the other (usually the female) is considerably lighter. The Blackbird (*Turdus merula*) and the Black Grouse (*Lyrurus tetrix*) are good examples of this. The geographical variation of the colour as well as colour polymorphism are definitely more pronounced in the female sex or entirely restricted to it. In the Jackdaw the pigment saturation does not reach, not even in the darker parts of the plumage, the level at which the colour variation becomes eliminated. Consequently, a well-developed though gently-sloping cline of increasing colour saturation of the whole plumage runs south- and southwestward from northern Europe to western Europe and the British Isles. But, as is to be expected, the silvery collar on the hind neck being less saturated with black pigment undergoes considerably more variation in the same direction. It actually forms, together with the white patch at the sides of the neck, the main basis for intraspecific taxonomy of this species.

As a relatively light-coloured area, the silvery collar is more susceptible also to the individual variation than the other parts of the plumage. This variation is, however, the less pronounced, the darker, on an average, is the population concerned. It is, therefore, quite comprehensible that within the westernmost populations no differences worth mentioning (except those between the age classes) can be observed between specimens of comparable date of collecting, even as regards the grey collar which is dark there.

In evaluating the circumstances prevailing in the West, a specimen in the Royal Museum of Natural History at Stockholm collected on Dec. 17 in Skabersjö, Skåne, serves as a good yardstick. This specimen seen by me in the collection has been mentioned by VOOUS (1950) as being almost identical with Western European *spermologus*. According to my notes, it is very dark indeed

on the hind neck, still darker than another specimen collected from Holmön on Dec. 12. The latter is also very dark, though lighter than *spermologus* which is represented by two small samples in the collection mentioned. Of these, the one originates in Netherlands and comprises 9 adults collected mostly in April. The other originates in England and comprises 7 adults collected in March. Though the collecting dates are well comparable, the collar of the English specimens is definitely darker and the other parts of the body plumage blacker than in the Dutch specimens. Due to this general darkness resulting in a conspicuous monotony of the samples, the individual variation in the collar is considerably decreased in the Dutch Jackdaws and even more so in the English Jackdaws, as compared with the more northern ones. Among the latter, the seasonal variation is more conspicuous due to abrasion, especially towards the spring, of the feather edges, which results in a much lighter silvery collar than in the freshly moulted plumage or in birds collected in midwinter. Besides this, the individual differences between the specimens of comparable dates of collecting are also greatly increased in comparison with those of the dark western representatives of the species.

Evident as it thus is that the individual variation of the silvery collar increases towards the North and Northeast, in those populations where the white patch occurs at the sides of neck, the situation is still more complicated due to the variability in the extension and clearness of the last-named characteristic. This is true in the Finnish population of which more than 50 % possess a well developed white patch. The question then arose whether there is any dependency between the development of the white patch and the colour of the silvery collar. From this investigation forming a part of the taxonomic analysis of the Finnish Jackdaws it appeared that the sex of the bird probably exerts some influence upon these relations; or in other words, some degree of sex dimorphism must be a characteristic of at least the "lighter" populations of the Jackdaw. The aim of the present paper is to examine how pronounced this dimorphism actually is in the Finnish population belonging to the "light" type.

Material and methods

The material studied comprises 80 Finnish breeding Jackdaws, collected on dates varying between 25th April and 4th June. In addition, 33 adult birds collected in a non-breeding season have been examined.

Because of the considerable differences in the occurrence of the well-developed white patch in different parts of the country, the breeding birds were treated by colonies or groups of (mostly) nearby colonies. In each group the specimens were ordered according to the shade of the silvery collar beginning from the darkest one. Besides myself, two other persons possessing a good colour vision took part in arranging the specimens according to the grade of darkness in each case. With only some minor discrepancies the arrangement of the birds by the three participants resulted in the same order. As regards the doubtful or discrepant cases, the final decision was left to my collaborators.

Regarding the white patch at the sides of the neck, also varying quantitatively, six classes of variation (indicated as 0 to 5) were separated; the first two (0 and 1) either possess no white patch, or this is only slightly indicated as a narrow stripe just at the lateral fringe of the silvery collar.

Results

When ordered according to the degree of the pigmentation of the silvery collar, the sequence from the darkest to the lightest specimen in each colony or colony group is as indicated in Table 1 (F = female, M = male).

As it appears from the tabulation, the darkest specimens in each colony are females. In spite of this, the females are well represented also in the light end of the series in most cases whereas the males are few among the darker part of the samples.

If we divide each sample into two halves (indicated with dots in the tabulation above) and add them together on both sides of the dots, we get the following sex ratios for the dark and the light Jackdaws separately:

	Females	Males	n
Darks	85.0 %	15.0 %	34 + 6 = 40
Lights	40.0 %	60.0 %	16 + 24 = 40
			50 + 30 = 80

The Chi-square value for the 2×2 table above is 15.41 and this difference is statistically very significant ($P < 0.001$). We can thus conclude that the sexes differ in the colour of the silvery collar, the females averaging darker. The darkest individuals in the population are females; the lighter, and even the lightest ones, can be of either sex, but the great majority of the males (80 %) belong to the light portion of the samples.

Next considered was the presence (or absence) of the white patch and its size when present. All size classes are represented in both sexes. But as can be seen from the following table, the males possess, on an average, a larger patch than the females (Student's t-test: $t = 1.885$, $P < 0.05$ (one sided!); 78 d.f.):

	Size Classes						Mean	n
	0	1	2	3	4	5		
F	17	7	12	8	4	2	1.62	50
M	4	6	7	5	7	1	2.27	30

The difference between the sexes in the mean size of white patch arises mainly from the frequencies of (a) the total absence of white at the sides of the neck and (b) the size class 4, both being very different in different sexes ($P = 0.026$ and 0.044 respectively; Fisher and Yates' exact contingency test). The females thus differ from the males in that the development of white at the fringe of the silvery collar is more often lacking in them and in that the greater size classes are relatively scarcer in them.

TABLE 1. See text.

Ahvenanmaa (Åland)	F F F M M . F M F M M	= 10
Korppoo, Kemiö, Pertteli, Kiikala, Siuntio	F F F F F F F . M M F M M M M	= 14
Lempäälä, Tyrvää, Pälkäne, Hattula	F F F M F F F F M . M M F M M F M F	= 17
Urjala	F F F F F F F F M . M F M M F F F F M	= 18
Pernaja	F F F . M F F	= 6
Lappeenranta	F F F F F F M . M F M M F M F M	= 15
Total		80

Among the specimens collected during the non-breeding season between October 10 and April 18, the sequence of the individuals according to the degree of the collar colouration is indicated in Table 2.

Compared with the breeding birds, the sexes are more evenly distributed along the series of increasing pigmentation of the collar. The ratio females: males, being quite even among the light part of the sample, does not deviate significantly from the 1:1 ratio even among the darks, as shown by the following table.

	Females	Males	n
Darks	58.9 %	41.1 %	10 + 7 = 17
Lights	50.0 %	50.0 %	8 + 8 = 16
			18 + 15 = 33

The observed difference between the dark and the light group is not statistically significant ($\chi^2_c = 0.025$). Among the males, the frequency of the light individuals is only 53 % as against 80 % among the breeding males ($P = 0.052$ or 5.2 %). In the non-breeding population no appreciable difference thus exists in the average colour of the silvery collar between the sexes.

Regarding the white patch, in this group of winter specimens, there is a still greater difference between the sexes in the average size of the white patch ($t = 2.178$, $P < 0.025$ (one sided!); 31 d.f.):

	Size Classes						Mean	n
	0	1	2	3	4	5		
F	7	4	2	2	3	—	1.44	18
M	3	1	1	4	5	1	2.66	15

In this case the difference refers to the three darkest size classes 0—2, not to the 0-type alone as was the case among the breeding birds. The classes 3—5 are thus definitely more commonly represented among the males and the difference is statistically significant ($P = 0.024$).

As it appears from the results so far described, the males tend to be lighter than the females in those parts of the plumage where the intensity of pigmentation generally remains low. This applies as well to the silvery collar as a whole as to the white patch which is a part of the former. This returns us back to the question upon the possible dependency between the size of the white patch and the colour of the collar, the investigation of which led us to the discovery of the sex dimorphism described above.

TABLE 2. See text.

Åland, Korppoo, Turku, Taivassalo	F F F F F . F F F M F	= 10
South-coast, west of Helsinki + Helsinki	F F F M M M . M F F F M M	= 12
Urjala, Hauho, Loviisa	M F M F M M . M M F M M	= 11
Total		33

As can be seen from the following tabulation, there is no significant difference in the mean size of the white patch between birds possessing a light silvery collar and those possessing a dark one.

		Size Classes						n	$\bar{X}$	t
		0	1	2	3	4	5			
Summer birds	Darks	12	6	11	6	4	1	40	1.675	1.2229
	Lights	9	7	8	7	7	2	40	2.050	
Winter birds	Darks	6	3	2	3	3	—	17	1.647	0.2338
	Lights	4	2	1	3	5	1	16	2.375	

For 78 degrees of freedom the probability is between .20 and .30 that t would fall outside the limits ± 1.2229, and for 31 degrees of freedom the probability is between .80 and .90 that t would fall outside the limits ± 0.2338. Our conclusion thus is that the development of the white patch and the colour of the silvery collar probably are independent characters.

Discussion

Though the material so far available is rather limited for a discussion upon some of the problems unfolded during this study, our main problem, however, can be considered as being elucidated with sufficient reliability. There is no doubt that, in the Jackdaw, the sexes differ in the average colour of their collars, the females being darker than the males of the same breeding population.

Because of the fact that the females, though representing the darkest individuals of a given population, also appear as light individuals not differing from the light males, this sex dimorphism is quantitative in character and thus possesses only a limited value for the discrimination of the sexes in the field. In a flock of Jackdaws feeding for example on a grass-plot of a park, it is not difficult to distinguish between dark and light individuals. But the association with sex is possible to judge only if the birds are keeping in pairs. The darker the bird's collar, the more likely that the bird is a female.

As has been mentioned in the introductory paragraph, the silvery collar becomes lighter throughout the winter season and especially in the spring (HARTERT 1910—38, HORTLING 1929—31, VOOUS 1950). This occurs through the abrasion of the soft grey feather edges in the neck and at the sides of the neck resulting in the more silvery appearance of the individuals of both sexes towards the breeding season. The fact, however, that there is no appreciable difference between the sexes in the collar of individuals collected during the non-breeding season, shows that the abrasion of the feather edges advances faster in the males. As a consequence, the sex difference is, averagely, more accentuated among the breeding birds than among the specimens wearing the winter plumage.

Our problem thus is why the abrasion leaves the females more intact than the males. The solution is probably to be found from the fact, also observed under this investigation, that the feathers of the silvery collar are, on an average, longer in the males than in the females and therefore more exposed to abrasion. This detail, however, needs further study.

Regarding the white patch at the sides of the collar, the average tendency is that it becomes larger in the males.

Contrary to the case with the silvery collar, this difference holds true both for the summer birds and for the individuals collected during the winter months. The difference between the sexes, however, is considerably greater among the winter birds: 2/3 of the collected males belong to the size classes 3—5 whereas among the summer birds they amount to less than 50 %. Though not statistically quite significant ($P = 0.087$ or 8.7 %; exact contingency test of Fisher & Yates), this difference may be an indication of an influence caused by the migrant birds of more remote origin. Of the 24 specimens collected during the migration period (October—November and March—April), 11 represent the size classes 3—5 and 8 of these are males. They probably come from the East, and it is the predominance of these males which contributes, among the winter birds, to the greater difference between the sexes.

Summary

Contrary to expectation the sex dimorphism in the Jackdaw is not restricted to the slight differences in size but applies also to the colouration. This is more apparent the "lighter" that a population is. In other words, the lighter the hue of the silvery collar of the individuals constituting a population, the more conspicuous becomes, on the average, the sexual dimorphism.

The sexes differ in the colour of the collar, the females averaging darker. The darkest individuals in a breeding population are females, but the lightest individuals can belong to either sex. Nevertheless, the great majority of the males belong to the lighter portion of the samples.

In the non-breeding population the colour-difference is considerably smaller or lacking. This shows that the abrasion towards the spring of the soft feather edges of the grey collar advances faster in the males, as a consequence of which the sex difference is on the average more accentuated among the breeding birds than among those wearing the winter plumage. The mechanics of this differential wear are possibly to be found in the different structure of the pertinent feathers; these feathers average longer in the males and are thus more exposed to abrasion.

The average size of the white patch at the sides of the collar also is different in different sexes. The larger size classes are less often present in the females, and, moreover, the patch is definitely more often totally absent in them. Contrary to the colour of the silvery collar, this difference holds true for birds collected in every season. However, the relatively high frequency of the size classes 3—5 among the non-breeding males may be caused by migrants of more remote origin.

Selostus: **Naakan sukupuolienvälisistä värieroista.**

Naakan sukupuolet eroavat toisistaan niskan ja kaulan sivujen värin puolesta siten, että naaraalla sanottujen alueiden harmaa väri on keskimäärin tummempi. Pesivässä kannassa tummimmat yksilöt ovat naaraita, mutta vaaleimmat naakat voivat olla kumpaakin sukupuolta. Suurin osa koiraista kuuluu kuitenkin muuntelusarjan vaaleampaan päähän. Sulkasadon jälkeisessä puvussa ja keskitalvella erot ovat tuntuvasti vähäisemmät tai puuttuvat. Tämä osoittaa, että harmaan "kauluksen" pehmeät höyhenreunukset kuluvat koirailla nopeammin kuin naarailla. Seurauksena on, että sukupuolien välinen ero on suurempi pesimäajan alussa kuin talvipuvussa olevilla linnuilla. Syynä nopeampaan kulumiseen on luultavasti se tutkimuksessa havaittu seikka, että niskan ja kaulan sivujen harmaat höyhenet ovat koirailla keskimäärin pitemmät ja näin ollen alttiimmat kulumiselle kuin naarailla.

Myöskin kaulan sivuilla oleva valkea laikka, joka meikäläisillä naakoilla esiintyy vaihtelevan suuruisena yli puolella linnuista, on keskimääräiseltä kooltaan erilainen eri sukupuolilla. Naarailla sanottu täplä puuttuu yleisemmin kuin koirailla ja suurikokoiset täplät ovat niillä suhteellisesti harvinaisempia. Tämä ero pätee kaikkina vuodenaikoina. Suurikokoisten täplien suhteellisen runsas esiintyminen talviaikaisilla koirailla johtuu todennäköisesti kauempaa alueellemme muuttaneista tai läpimuuttavista yksilöistä.

References

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KAKSI BIGAMIA-TAPAUSTA KIVITASKULLA (*OENANTHE OENANTHE*)

MARKKU ARO

Kirjallisuustietojen mukaan on moniavioisuutta kivitaskulla havaittu vain kolmesti; kahdesti vuonna 1953 Ruotsissa (JENNING 1954) sekä vuonna 1958 Saksassa (MENZEL 1964). Kesällä 1967 totesin kuitenkin Helsingin edustalla olevalla Melkin saarella (60°08'N, 24°54'E) kaksi bigamia-tapausta tällä lajilla. Tutkimani linnut olivat yksilöllisesti värirenkain merkittyjä.

Tapaus A

Avoimella kivikkorannalla pesineen parin komea, yli 2-vuotias koiras oli vallannut itselleen suuren reviirin (A_1, Kuva 1). Koirasta ei kuitenkaan usein tavannut reviiriltä, josta pesä löytyi tervaleppävyöhykkeeseen rajoittuvan avoimen rantavyöhykkeen reunasta keskikokoisen kiven alla olevasta onkalosta. Kuudesta munasta ensimmäinen ilmestyi 15. 5. ja naaras (♀ 1) aloitti haudonnan 20. 5. Poikaset kuoriutuivat 3. 6., ja molemmat emot ruokkivat niitä alusta pitäen. Tehdessäni pesälle tarkistuskäyntejä, ♂ oli kullakin kerralla erittäin kiihtynyt ja varoitteli intensiivisesti, kun taasen ♀ 1 aina vetäytyi läheisen harvan männikön suojaan. Vielä 19. 6. pesässä oli yksi poikanen, jota molemmat emot ruokkivat. 20. 6. pesä tavattiin tyhjänä, ja totesin emojen ja ainakin kolmen poikasen siirtyneen pesästä n. 300 m:n päässä olevalle avokalliolle. Vielä 22. 6. ♂:kin huolsi poikasia ja ♀ 1 aina 2. 7. saakka.

Reviiriltä A_2, joka sijoittui em. avokallion alle kapealle rantavyöhykkeelle ja pieneen metsikköön, löytyi yllättäen pesä 2. 7. kahden toisiinsa nojaavan suuren kiven välissä olevasta onkalosta. Pesässä oli viisi poikasta, iältään n. 10 vrk. Kuoriutuminen oli näinollen tapahtunut n. 23. 6. ja muninta alkanut n. 4. 6. Poikasille ruokaa tuonut naaras (♀ 2) oli rengastamaton, ja sen merkitsinkin; ♂