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GEOGRAPHIC VARIATION AND SUBSPECIES OF *CORVUS ENCA* (HORSFIELD, 1821)

by

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In this paper a survey is given of the geographic variation and the subspecies of *Corvus enca* (Horsfield). For that purpose the collections of the Rijksmuseum van Natuurlijke Historie in Leiden and the Zoölogisch Museum in Amsterdam were studied and compared with the literature. My examinations resulted in the following division of subspecies:

- *Corvus enca compilator* Richmond: Malaya, Sumatra, Simalur, Nias, Borneo, (Rhio Archipelago).
- *Corvus enca enca* (Horsfield): Java, Bali, Celebes, Sula Islands, (Mentawei Islands).
- *Corvus enca violaceus* Bonaparte: Ceram (and perhaps Buru).
- The birds from Mindoro, Samar, Mindanao, Palawan, Balabac and Luzon possibly belong to two or three subspecies.

Geographic variation also appears to exist among the populations of *C. e. compilator* of the various islands this subspecies inhabits. Besides geographic variation I found differences between the sexes as well: males have a larger bill and wing length than females.

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1. INTRODUCTION

The Slender-billed Crow *Corvus enca* (Horsfield, 1821) is a polytypic species which inhabits Malaya, the East Indies and the Philippines (fig. 1). It is a small or medium-sized crow, with a proportionally short tail (about half the wing length). The wing is very rounded and the outer primary is relatively long. The bird is black with a purplish sheen but not very glossy. The bases of the feathers on the nape and breast are white. The throat feathers are only a little lanceolated. The post-ocular region is bare. *C. enca* has a rather slender bill, which is bare at the base of the culmen.

The species shows geographic variation consisting of differences in size and in the colour and intensity of the gloss. In the literature there is disagreement on the division into subspecies. Summarily the situation is as follows:

(1) Everyone agrees on the subspecies *Corvus enca compilator* and its geographic distribution.
(2) There are differences of opinion on the subspecific identity of the populations of the Mentawei Islands, Java, Bali, Celebes and the Sula Islands.
(3) There is general agreement that the birds of Ceram form a separate race; some look upon *violaceus* as a distinct species.
(4) The subdivision of the species in the Philippines gives some problems too.
(5) Three different opinions on *unicolor* from Banggai exist: A. it is a subspecies of *Corvus enca;* B. it is a subspecies of *C. typicus;* C. it is a separate species (*C. unicolor* (Rothschild & Hartert)).

In this paper the literature is considered and collated on the basis of a study of the collections of the Rijksmuseum van Natuurlijke Historie in Leiden and the Zoölogisch Museum in Amsterdam. Thus it is attempted to marshal the facts concerning the five groups I mentioned. In addition I checked how far variations within populations may be the result of sexual dimorphism.

2. MATERIAL AND METHODS

The above-mentioned museums had 151 adult specimens of *Corvus enca* of which the geographic origin was known: most of these were from Sumatra, Simalur, Borneo, Java, Celebes, the Sula Islands and Ceram. These collections did not contain specimens from the Rhio Archipelago, the Mentawei Islands and the Banggai Islands. Two birds of Mindoro were the only representatives from the Philippines.

Of every bird I took the following measurements: the length of wing, tail, tarsus and bill, and the depth of the upper half of the bill. All measurements in mm. Besides, the tail/wing index, the bill/wing index and the hand-wing index were calculated. The hand-wing index gives the distance between the outer secondary and the wing-tip as a percentage of the total wing length and is a measure for the pointedness of the wing (Kipp, 1959).

With the results of these measurements and the comparisons of colour and sheen of the crows I determined the differences between the various populations and came to a division into subspecies in an as objective manner as possible. In doubtful cases the 75%-rule was applied as is set out by Amadon (1949).

For the three best-represented islands (Sumatra, Java and Celebes) I com-

pared the male birds with the females, in order to determine any differences between the sexes.

3. RESULTS

3.1. *Corvus enca compilator* Richmond, 1903

All authors agree that the birds from Malaya, Sumatra, Borneo, Simalur, Nias and the Rhio Archipelago belong to the subspecies *C. e. compilator*. This subspecies is characterized by its large size. Wing, tail, bill and tarsus are longer than in the other populations. Bill and tail are not only absolutely but also relatively longer than on most of the other islands. Only the crows of Ceram and Mindoro have a larger tail/wing index than *compilator* (figs. 2-7, 10, 11; table 1). The gloss of *compilator* is more intense and more bluish than

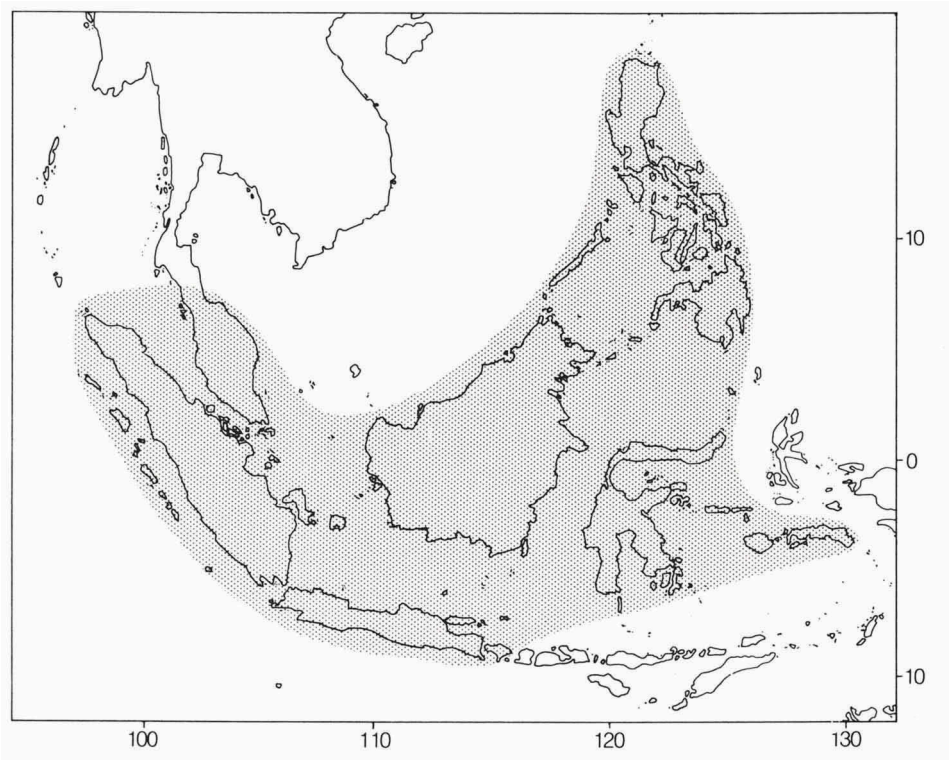

Fig. 1. Distribution area of *Corvus enca*.

that of the other races, and the colour is somewhat darker. This conforms with the findings of most other authors except Meinertzhagen (1926) who does not see any difference with *C. e. enca,* and Goodwin (1976) who states that *C. e. enca* is blacker and more glossy.

In order to detect any intra-subspecific geographic variation, I also compared the populations of the three islands Simalur, Sumatra and Borneo. I did

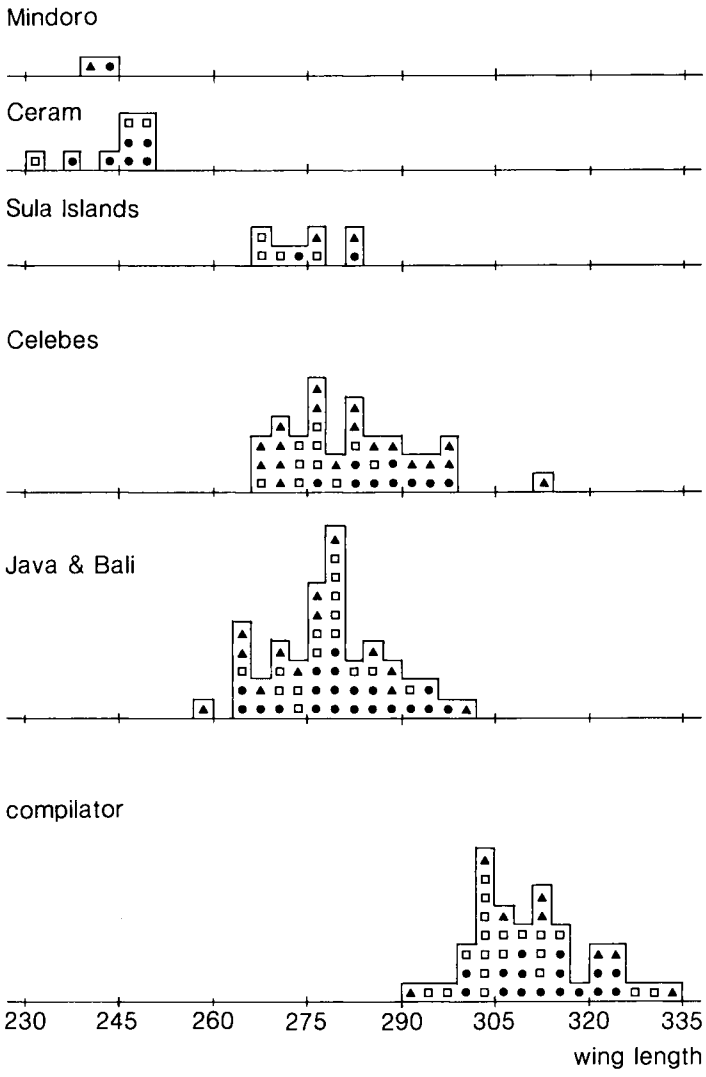

Fig. 2. *Corvus enca*: wing length of each group. Each symbol represents one specimen. Dot: male; square: female; triangle: sex unknown.

not notice any differences in colour and gloss. Regarding the various measurements, there are some differences in the average values, but because of the enormous overlap it is clear that an eventual recognition of separate subspecies is out of the question. The differences between the birds from Sumatra and Simalur generally appear to be the largest, the birds from Borneo being intermediate (figs. 8, 9; table 2).

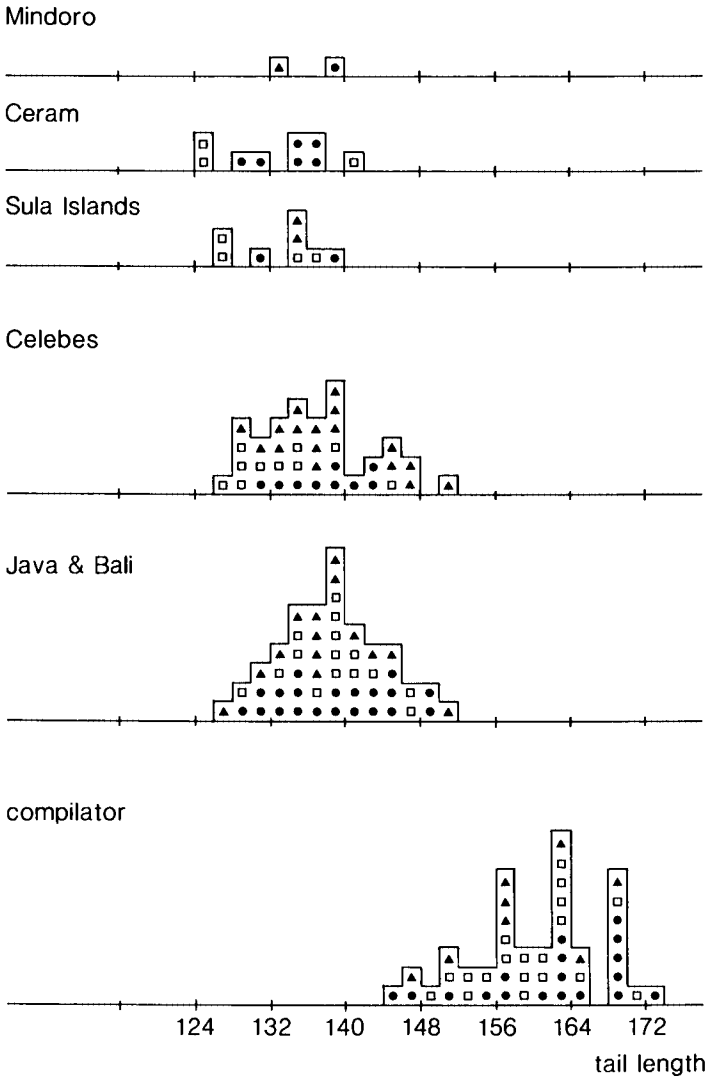

Fig. 3. Tail length (see fig. 2).

3.2. Java, Bali, Celebes, Sula Islands (*Corvus enca enca* (Horsfield, 1821))

The crows of these islands are intermediate in size between *C. e. compilator* and the rest. There is much diversity of opinion as to the question whether this group should be divided into separate subspecies.

According to Meinertzhagen (1926) *C. e. enca* inhabits Java and the Men-

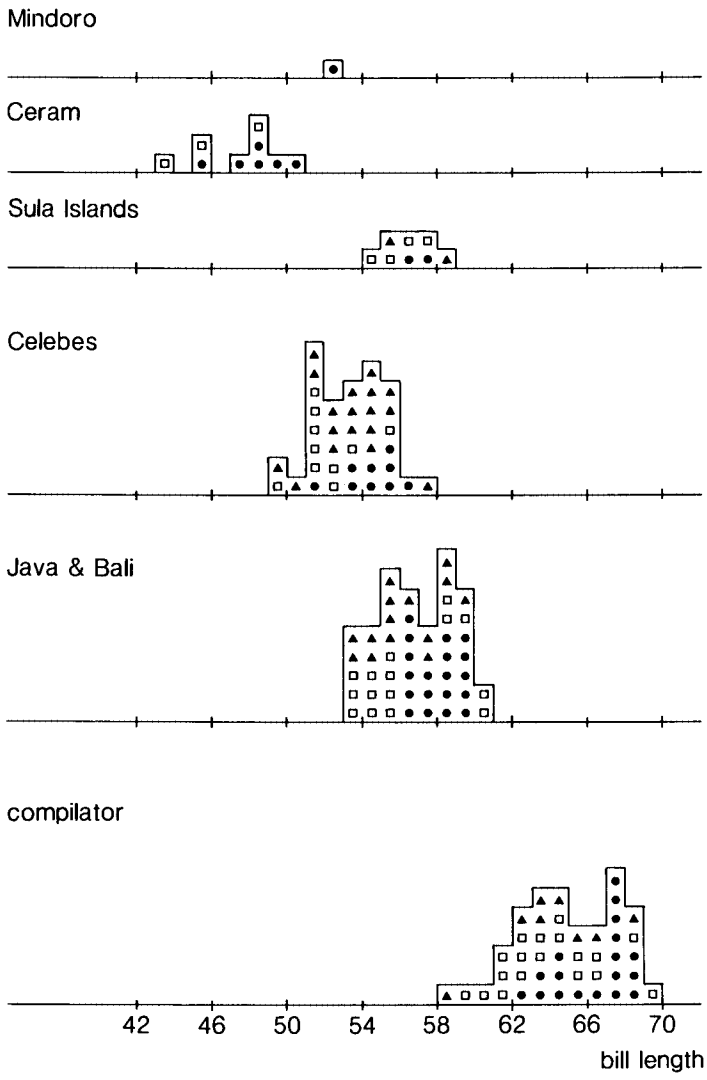

Fig. 4. Bill length (see fig. 2).

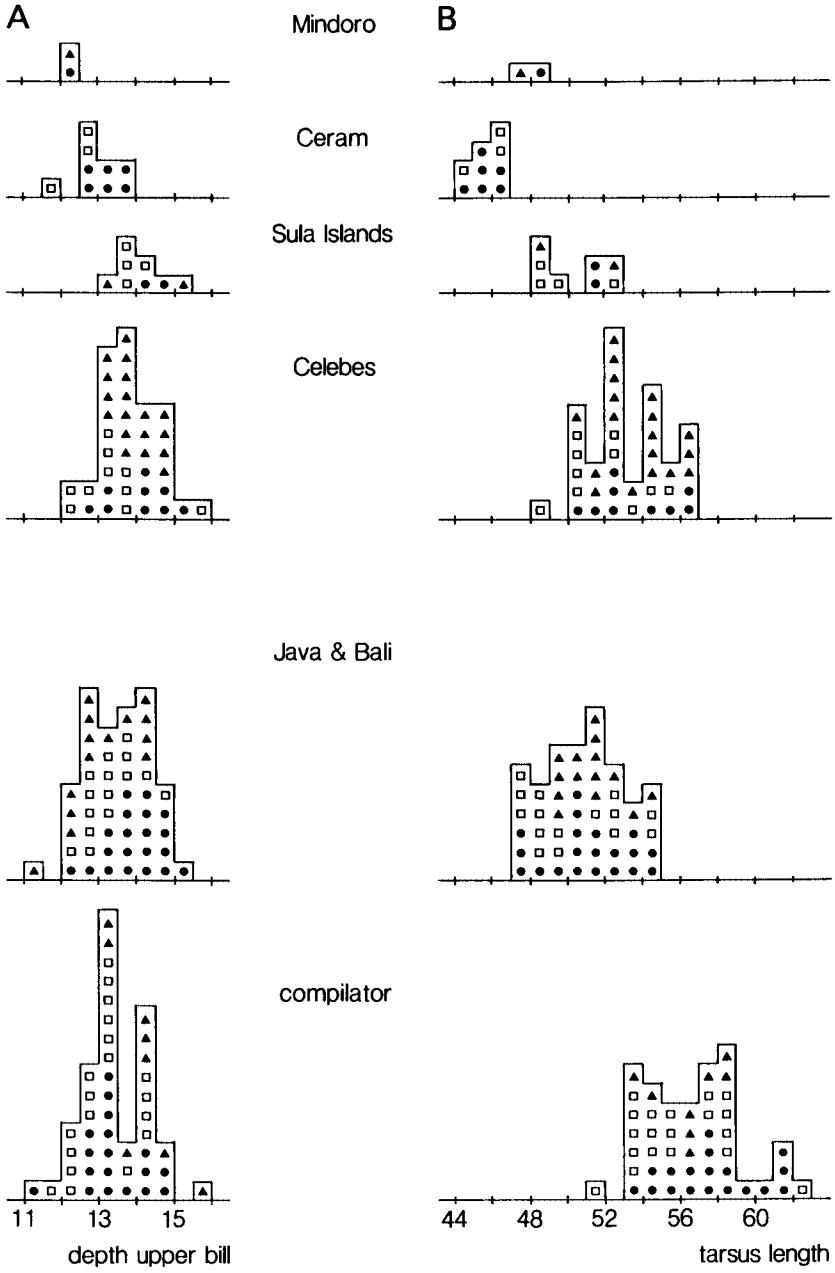

Fig. 5. A: depth upper bill; B: tarsus length (see fig. 2).

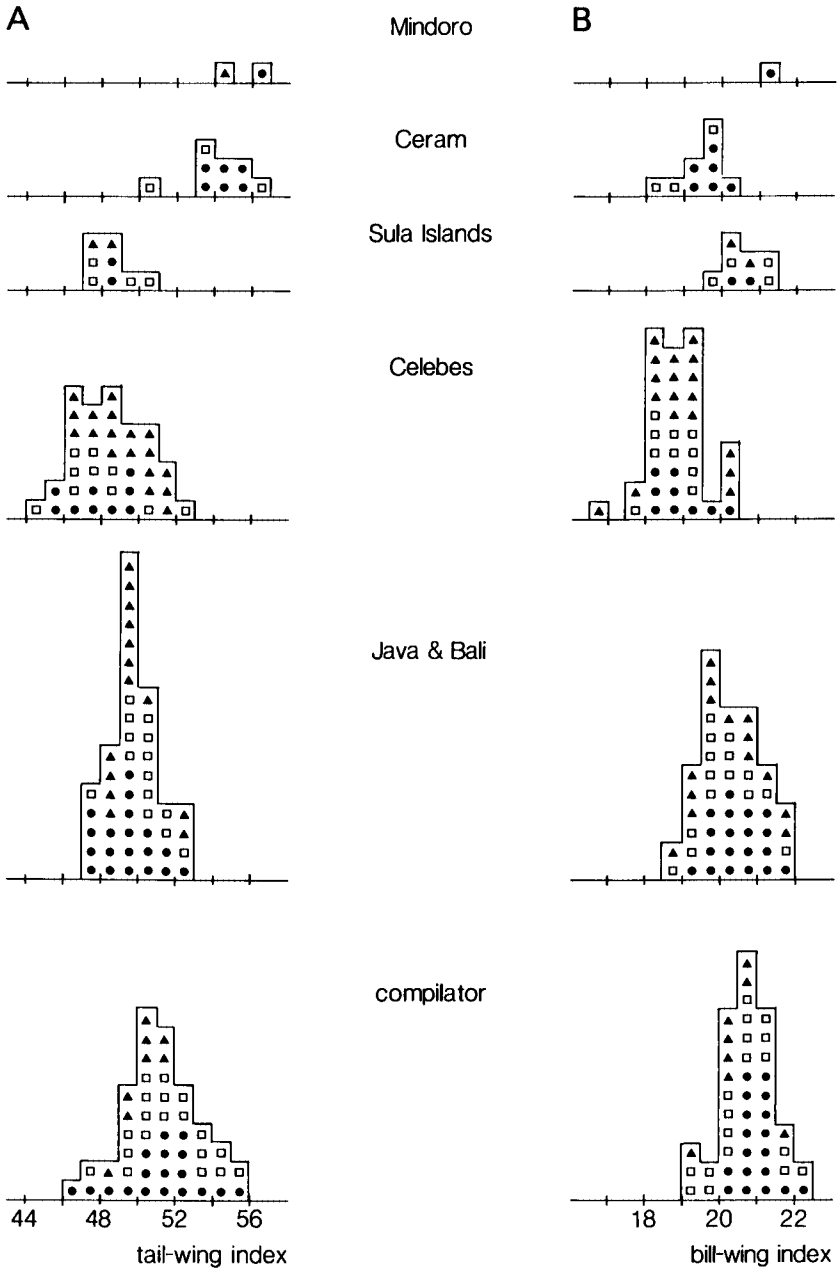

Fig. 6. A: tail/wing index; B: bill/wing index (see fig. 2).

tawei Islands; the birds of Celebes, Bali and the Sula Islands belong to another subspecies which he does not give a name. He states that these birds are smaller and generally darker than *C. e. enca*.

Stresemann (1936) describes the subspecies *C. e. celebensis,* which does not differ from *C. e. enca* in size and colour but has a "less slender bill, averaging somewhat shorter and higher".

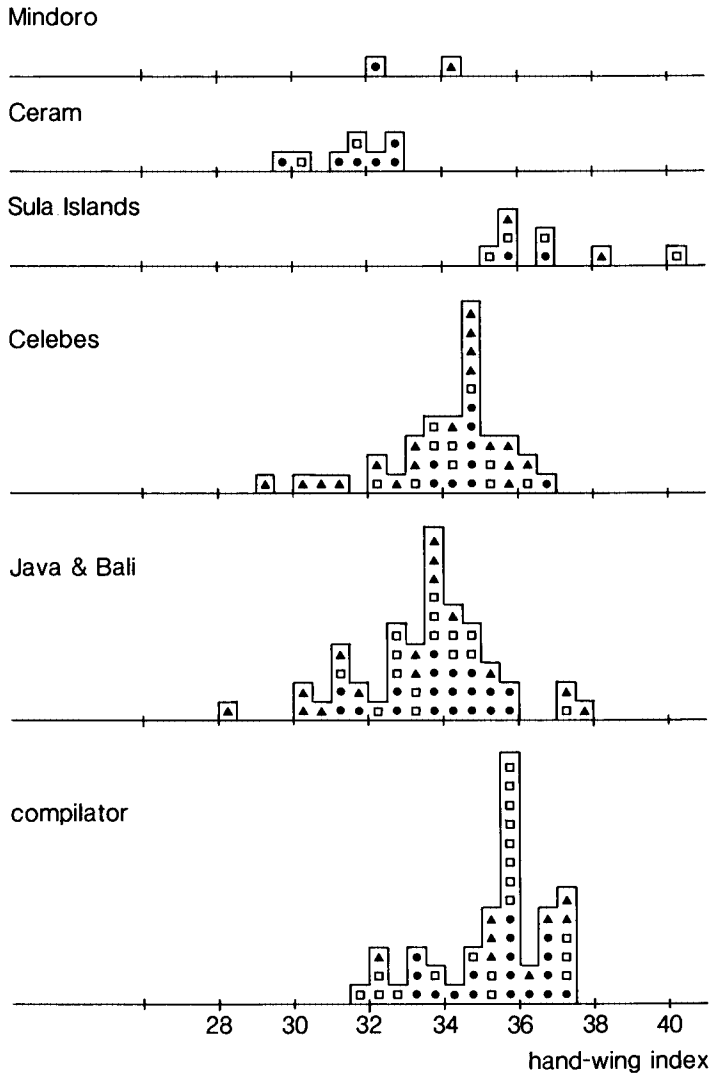

Fig. 7. Hand-wing index (see fig. 2).

	Total	♂♂	♀♀
Wing length			
compilator	311.0 (45)	313.5 (18)	307.9 (19)
Java & Bali	278.6 (49)	280.8 (20)	277.5 (15)
Celebes	282.0 (37)	287.4 (9)	277.1 (10)
Sula Islands	274.0 (8)	277.0 (2)	269.9 (4)
Ceram	243.9 (9)	244.8 (6)	242.3 (3)
Mindoro	242.8 (2)	244.5 (1)	–
Tail length			
compilator	159.7 (45)	161.1 (18)	159.2 (19)
Java & Bali	138.3 (49)	138.5 (20)	139.0 (15)
Celebes	136.4 (37)	137.3 (9)	132.9 (10)
Sula Islands	132.6 (8)	134.5 (2)	130.8 (4)
Ceram	132.3 (9)	133.5 (6)	130.0 (3)
Mindoro	135.5 (2)	139 (1)	–
Bill length			
compilator	64.6 (44)	65.9 (18)	63.6 (18)
Java & Bali	56.6 (48)	57.7 (19)	55.9 (15)
Celebes	53.1 (37)	54.2 (9)	51.8 (10)
Sula Islands	56.3 (8)	56.8 (2)	55.6 (4)
Ceram	47.2 (9)	48.0 (6)	45.7 (3)
Mindoro	52.0 (1)	52.0 (1)	–
Bill depth			
compilator	13.2 (45)	13.1 (18)	12.9 (19)
Java & Bali	13.2 (49)	13.7 (20)	13.0 (15)
Celebes	13.6 (37)	13.8 (9)	13.2 (10)
Sula Islands	13.9 (8)	14.3 (2)	13.6 (4)
Ceram	12.7 (9)	13.0 (6)	12.2 (3)
Mindoro	12.0 (2)	12.0 (1)	–
Tarsus length			
compilator	56.5 (45)	57.5 (18)	55.7 (19)
Java & Bali	50.8 (49)	51.5 (20)	50.1 (15)
Celebes	53.1 (37)	53.5 (9)	51.9 (10)
Sula Islands	50.2 (8)	51.3 (2)	49.4 (4)
Ceram	45.6 (9)	45.7 (6)	45.6 (3)
Mindoro	47.8 (2)	48.3 (1)	
Tail/wing index			
compilator	51.4 (45)	51.4 (18)	51.7 (19)
Java & Bali	49.7 (49)	49.3 (20)	50.1 (15)
Celebes	48.4 (37)	47.8 (9)	48.0 (10)
Sula Islands	48.4 (8)	48.5 (2)	48.4 (4)
Ceram	54.2 (9)	54.5 (6)	53.6 (3)
Mindoro	55.8 (2)	56.9 (1)	–

	Total	♂♂	♀♀
Bill/wing index			
compilator	20.8 (44)	21.0 (18)	20.7 (18)
Java & Bali	20.3 (48)	20.5 (19)	20.1 (15)
Celebes	18.8 (37)	18.9 (9)	18.7 (10)
Sula Islands	20.5 (8)	20.5 (2)	20.6 (4)
Ceram	19.4 (9)	19.6 (6)	18.8 (3)
Mindoro	21.3 (1)	21.3 (1)	–
Hand-wing index			
compilator	35.3 (45)	35.3 (18)	35.0 (19)
Java & Bali	33.6 (49)	33.6 (20)	33.7 (15)
Celebes	34.1 (37)	34.7 (9)	34.3 (10)
Sula Islands	36.8 (8)	36.3 (2)	37.0 (4)
Ceram	31.3 (9)	31.8 (6)	30.1 (3)
Mindoro	33.4 (2)	32.3 (1)	–

Table 1. *Corvus enca:* average sizes and indices for each group. In parentheses the number of specimens examined; all sizes in millimetres.

Dorst (1947) considers this group as one subspecies (*C. e. enca*).

Van Bemmel (1948) ascribes the birds of the Sula Islands to *celebensis,* but states that the few specimens he saw seem to be intermediate between *C. e. enca* and *C. e. celebensis.*

Vaurie (1958) also sees differences between *C. e. enca* of Java, Bali and the Mentawei Islands and *C. e. celebensis.* The birds from Celebes are not only distinguished by the proportions of the bill, but are also a little smaller and slightly more blackish and more glossy. Besides he describes a new subspecies *C. e. mangoli* on the basis of two specimens from the island Mangoli; the long bill is the main subspecific character. Moreover *celebensis* is darker and glossier, and *C. e. enca* is larger.

Unlike Vaurie, Eck (1975) is unable to distinguish *C. e. enca* and *C. e. mangoli* on the basis of measurements and ratios. But he finds a larger hand-wing index in *mangoli* and states that the birds from Sula are darker on the crown and nape than those from Java. According to Eck *C. e. celebensis* clearly differs from the other two subspecies by its smaller bill and more intensive purple gloss.

Goodwin (1976) splits the group into three sections according to bill size: the average bill length of *mangoli* is larger; *celebensis* has a shorter and thicker bill.

In my opinion the birds of Java, Bali, Celebes and the Sula Islands are indistinguishable by colour and gloss. Regarding the measurements it appears

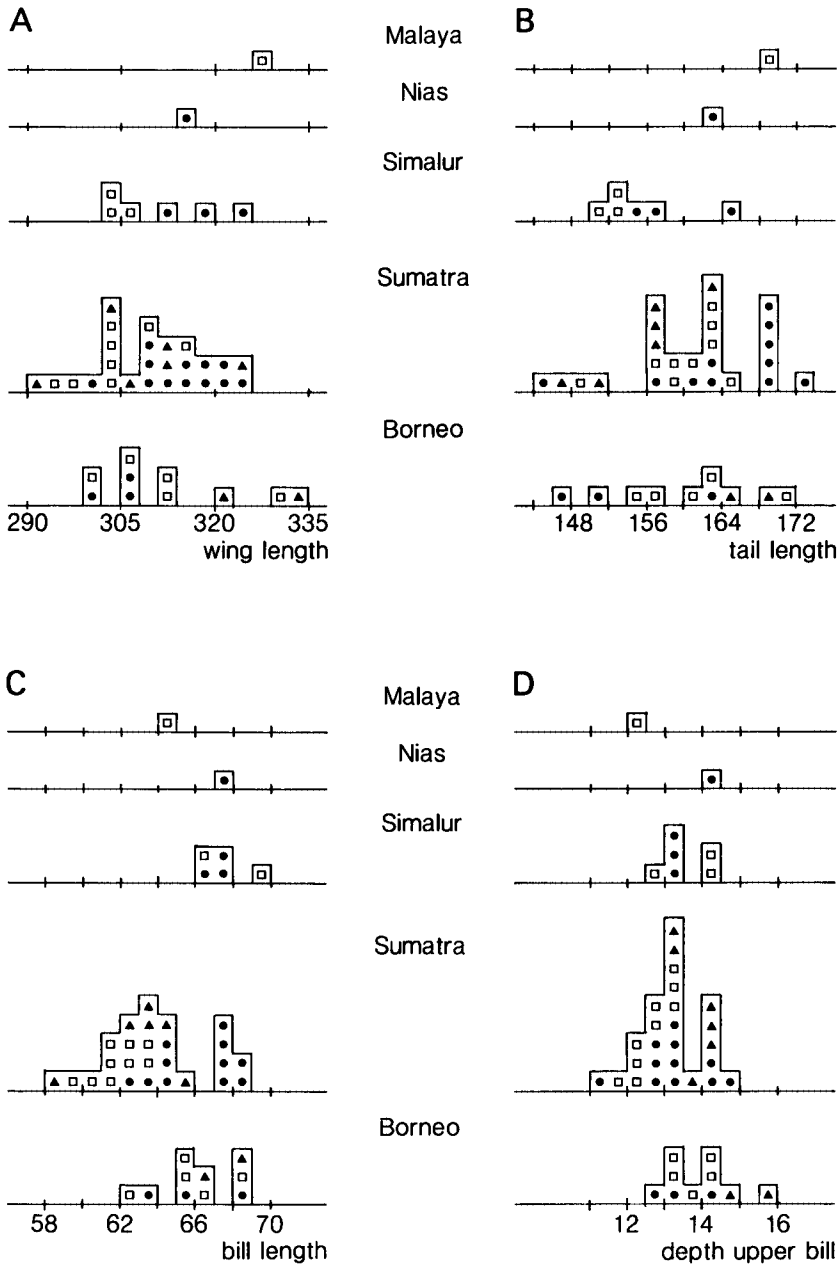

Fig. 8. Measurements of *C. e. compilator* on different islands. Each symbol represents one specimen. Dot: male; square: female; triangle: sex unknown. A: wing length; B: tail length; C: bill length; D: depth upper bill.

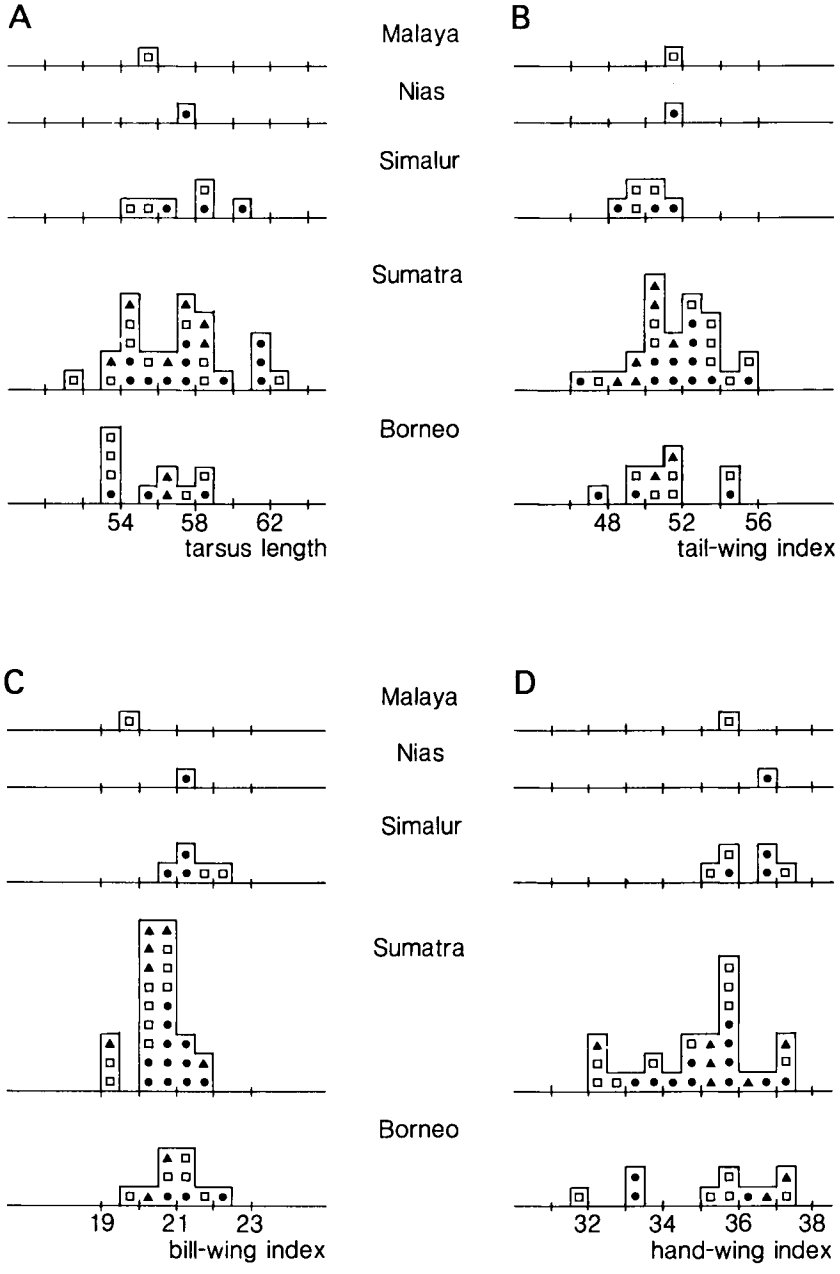

Fig. 9. *C. e. compilator*: A: tarsus length; B: tail/wing index; C: bill/wing index; D: hand-wing index. (see fig. 8).

that there are indeed some significant differences between the three supposed subspecies (Mann-Whitney U-test, two-sided, threshold value 0.05):

- Birds from Java have a larger tail/wing index than those from Celebes and the Sula Islands ($p = 0.0001$ and $p = 0.0136$, respectively).
- On Celebes the bills are absolutely and relatively shorter than on Java and the Sula Islands (in each case $p < 0.0002$).

	Total	♂♂	♀♀
Wing length			
Borneo	312.9 (10)	304.3 (3)	312.7 (5)
Sumatra	309.7 (26)	314.6 (11)	304.8 (9)
Simalur	311.3 (6)	318.0 (3)	304.7 (3)
Tail length			
Borneo	159.7 (10)	153.3 (3)	161.0 (5)
Sumatra	160.3 (26)	163.8 (11)	159.6 (9)
Simalur	155.2 (6)	158.7 (3)	151.7 (3)
Bill length			
Borneo	65.8 (10)	65.5 (3)	65.4 (5)
Sumatra	63.5 (26)	65.6 (11)	61.6 (9)
Simalur	67.3 (5)	67.0 (3)	67.8 (2)
Bill depth			
Borneo	13.7 (10)	13.2 (3)	13.5 (5)
Sumatra	13.0 (26)	13.1 (11)	12.4 (9)
Simalur	13.3 (6)	13.0 (3)	13.5 (3)
Tarsus length			
Borneo	55.5 (10)	55.6 (3)	55.1 (5)
Sumatra	56.9 (26)	57.8 (11)	56.2 (9)
Simalur	57.3 (6)	58.3 (3)	56.3 (3)
Tail/wing index			
Borneo	51.0 (10)	50.4 (3)	51.5 (5)
Sumatra	51.8 (26)	52.1 (11)	52.4 (9)
Simalur	49.8 (6)	49.9 (3)	49.8 (3)
Bill/wing index			
Borneo	21.0 (10)	21.5 (3)	20.9 (5)
Sumatra	20.5 (26)	20.9 (11)	20.2 (9)
Simalur	21.5 (5)	21.1 (3)	22.2 (2)
Hand-wing index			
Borneo	35.3 (10)	34.3 (3)	35.2 (5)
Sumatra	34.9 (26)	35.2 (11)	34.4 (9)
Simalur	36.2 (6)	36.4 (3)	36.0 (3)

Table 2. Average sizes and indices of *Corvus enca compilator* on the three best represented islands. In parentheses the number of specimens examined; all sizes in millimetres.

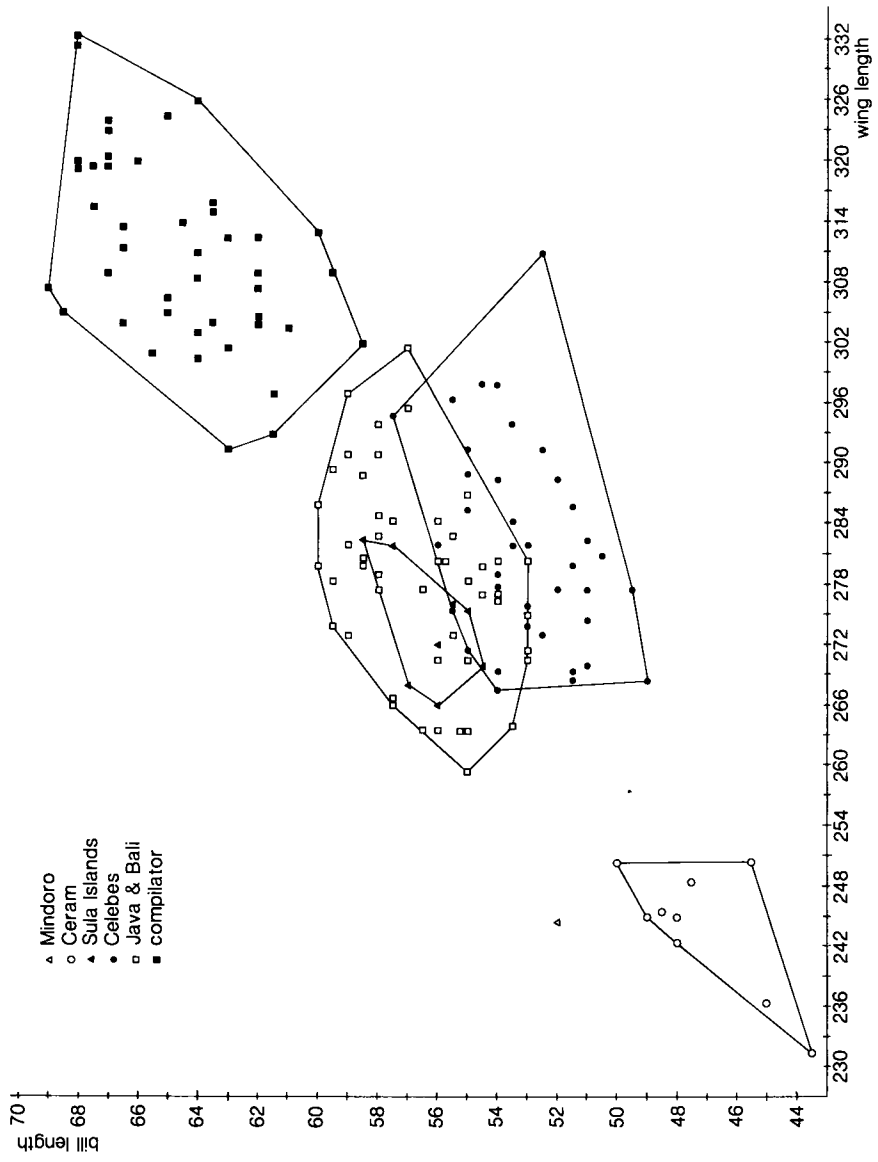

Fig. 10. Bill length against wing length of each specimen.

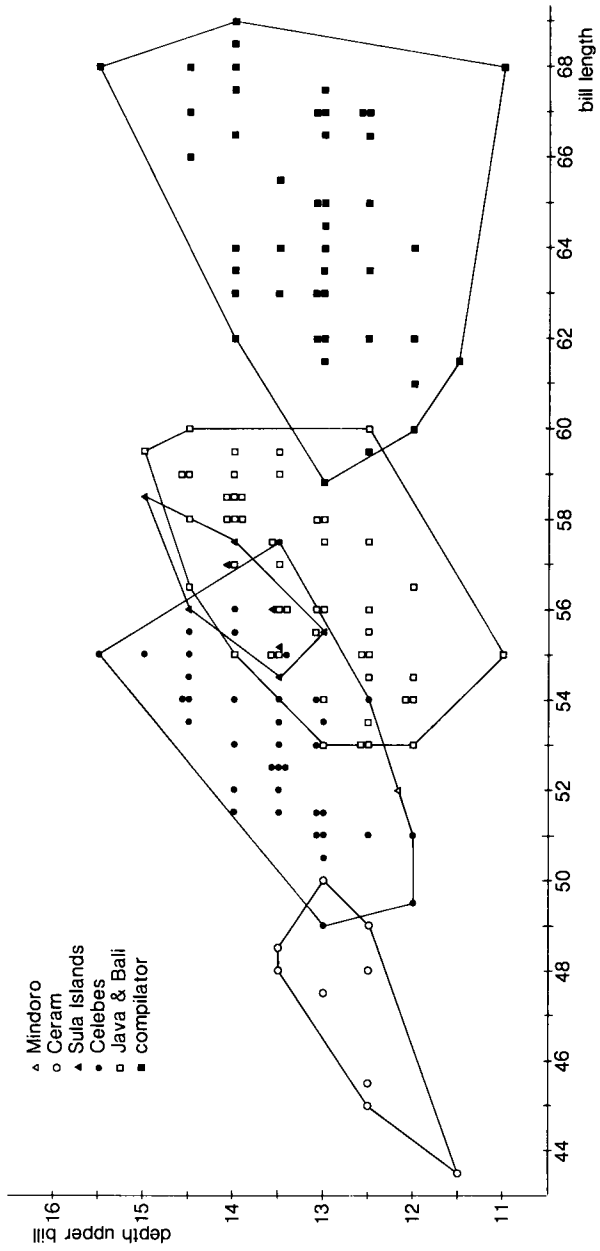

Fig. 11. Depth upper bill against bill length of each specimen.

- The tarsus of the birds from Celebes is longer than that of the birds from Java and the Sula Islands ($p < 0.0002$ and $p = 0.0022$, respectively).
- The birds from Sula have a larger hand-wing index than those from Java and Celebes ($p < 0.0002$ and $p < 0.0004$, respectively).

Looking at the figures the above-mentioned differences are indeed recognizable, but in each case there is an enormous overlap in measurements (figs. 2-7, 10, 11). In order to arrive at a more objective judgement of the degree of difference between the three groups and the consequences for the nomenclature, I used the 75%-rule (Amadon, 1949), based on a standard range of 6.48 times the standard deviation, and applied this to all characteristics in which two populations differ significantly. Comparing the birds from Java and Bali with those from Sula, I could thus recognize 10 of the 59 specimens as coming from one of those regions, that is 17.5%. The comparison Celebes with Java and Bali gave a ratio of 16.3% (14 of 86 birds), and the comparison Celebes with the Sula Islands 66.7% (30 of 45 birds). As none of these values exceeds 75%, the populations of Java, Bali, Celebes and the Sula Islands should be regarded as one subspecies: *C. e. enca* (I did not examine specimens from the Mentawei Islands).

3.3. Ceram (*Corvus enca violaceus* Bonaparte, 1850)

The smaller crows on Ceram are clearly recognizable as a separate race (*C. e. violaceus* Bonaparte, 1850) by their dull purplish plumage, almost without gloss. *Violaceus* is also very different from the above-mentioned subspecies in measurements and proportions (figs. 2-7, 10, 11). Some authors consider *violaceus* as a distinct species; Dorst (1947) describes *C. v. violaceus* as inhabiting Ceram, besides two other subspecies of *violaceus* on the Philippines. Goodwin (1976) writes about *C. e. violaceus*: "It may have reached specific level".

According to Van Bemmel (1948) *C. e. violaceus* perhaps also inhabits Buru (Vaurie, 1958).

3.4. The Philippines

Meinertzhagen (1926) describes three subspecies of *C. enca* on the Philippines, recognizable by colour and gloss. *C. e. pusillus* Tweeddale, 1878 inhabits Palawan and Balabac and is the palest bird with least gloss. Meinertzhagen states that the birds from Mindoro are generally glossier than *pusillus,* and describes these as a separate race without naming it. Finally he mentions *C. e. samarensis* Steere, 1890 of Samar and Mindanao, with a deep violet-blue plumage and a strong sheen.

According to Dorst (1947) the birds from the Philippines belong to *C. violaceus* but are glossier than the nominate form on Ceram. However, *C. v. pusillus* from Palawan and Balabac is duller underneath. The plumage of the birds of Samar, Mindanao and Mindoro has a strong sheen; Dorst brings these populations together in the subspecies *C. v. samarensis.*

Vaurie (1958) states that the population on Mindoro agrees with that on Palawan and Balabac (*C. e. pusillus*); *C. e. samarensis* (Mindanao and Samar) is not only glossier and more purplish than *pusillus,* but also smaller.

Rand & Rabor (1961) describe a new subspecies *C. e. sierramadrensis* from Luzon and compare this with *samarensis:* the plumage is generally more intensely black and the bill is somewhat shorter and more slender.

I examined only two specimens from the Philippines (Mindoro). Those are the darkest birds of the collection and they show a relatively strong sheen. They conform with *C. e. violaceus* in many measurements. Only the bill and tarsus appear to be somewhat longer. It is notable that only in these two birds the seventh primary is longer than the second (counted from the outermost primary). It is clear that these birds from Mindoro belong to another subspecies than those from outside the Philippines. Obviously it is impossible to discuss the division into subspecies on the Philippines on the basis of these data only.

3.5. *Corvus unicolor* (Rothschild & Hartert, 1900)

Only two specimens from the Banggai Islands are known; unfortunaly I have not seen them. In view of their very small size it is clear that these birds do not belong to any of the above-mentioned subspecies. The question remains whether *unicolor* should be regarded as a subspecies of *C. enca,* as a distinct species, or as a subspecies of *C. typicus* (Bonaparte, 1853), the small black-and-white-coloured crow on Celebes. Meinertzhagen (1926) and Goodwin (1976) consider *unicolor* a separate species, Dorst (1947) calls it *C. typicus unicolor,* and Vaurie (1958) considers it a subspecies of *enca.*

As the distribution area of *unicolor* is completely surrounded by that of *C. e. enca,* I am of the opinion that this form is not a subspecies of *C. enca.* It seems reasonable to consider *unicolor* as a subspecies of *C. typicus,* as the coloration is apparently the only character that distinguishes *unicolor* from *typicus.*

3.6. Sexual variation

For the islands Sumatra, Java (and Bali) and Celebes I tried to establish whether there are any differences between the sexes, with the help of the Mann-Whitney U-test (two-sided, threshold value 0.05).

Males appear to have significantly longer bills than females: Java and Bali: $p = 0.0192$; Celebes: $p = 0.0046$; Sumatra: $p < 0.0003$. In addition I found that males are larger than females on Sumatra and Celebes (wing length): $p = 0.0108$ and $p = 0.0042$, respectively. On Java the males have deeper bills than the females ($p = 0.0098$). No other significant differences between the sexes appear from the measurements (see also figs. 2-9 and tables 1 and 2).

4. DISCUSSION

By application of the 75%-rule I came to other conclusions than Vaurie (1958) concerning *C. e. mangoli*, and Stresemann (1936) concerning *C. e. celebensis.*

Vaurie (1958) recognized *mangoli* because he examined two specimens from the Sula Islands which by chance rather differed in size from the average of the population. This shows that it is risky to draw conclusions concerning geographic variation on the basis of so few specimens.

Stresemann (1936) described *celebensis,* based on the average length and depth of the bill. But those small differences do not justify the distinction of a separate subspecies, as the overlap between the populations is too large, and less than 20% of the specimens is recognizable as inhabiting one island or the other.

Gloss and colour of the plumage in *C. enca* are practically useless for comparative purposes as is apparent from the many contradictions in the descriptions by the various authors. The cause of this is the great variation in plumage, partly as a result of moult and wear: freshly-moulted birds are relatively very dark and glossy, with a purple sheen, but as the plumage wears the colour becomes lighter and finally more brown than black, the purplish lustre disappearing more or less. In this respect too, individual variation may be considerable: in some moulting birds the difference between old and new feathers is very great; other birds show very little difference.

5. CONCLUSIONS

The main conclusion of this study is that the birds that were described as *C. e. enca, C. e. celebensis* and *C. e. mangoli* do not differ sufficiently to warrant the distinction of different subspecies, if the 75%-rule is applied. Like in *C. e. enca,* the populations of *C. e. compilator* on the various islands show a certain degree of geographic variation in the averages of some measurements.

C. e. violaceus of Ceram is well-differentiated and I agree with Goodwin (1976) who says that *violaceus* may have reached specific status.

The two specimens from Mindoro are also distinct. It is uncertain to which subspecies they belong, because the crows of Mindoro are sometimes regarded as a separate species (Meinertzhagen, 1926), sometimes as representing *C. e. samarensis* (Dorst, 1947), and sometimes as belonging to *C. e. pusillus* (e.g. Vaurie, 1958). This lack of agreement would suggest that the differences between the populations of the various Philippine Islands are so slight that, if the 75%-rule is applied, all these would appear to belong to one subspecies.

Reviewing the literature on the small crows from Banggai, I am of the opinion that these do not belong to *C. enca,* and that *unicolor* is perhaps more allied to *C. typicus.*

In my opinion *C. enca* thus consists of the following subspecies:

- *C. e. compilator*: Malaya, Sumatra, Simalur, Nias, Borneo, (Rhio Archipelago);
- *C. e. enca:* Java, Bali, Celebes, Sula Islands, (Mentawei Islands);
- *C. e. violaceus:* Ceram (and perhaps Buru);
- one, two or three subspecies on the Philippine islands of Mindoro, Samar, Mindanao, Palawan, Balabac and Luzon.

Besides geographic and individual variation, some sexual variation exists: males have longer bills than females and generally have longer wings (only on Java not significantly so: $p = 0.2040$).

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