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Functional significance of the uncinate processes in birds

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Summary

The functional significance of the uncinate processes to the ventilatory mechanics of birds was examined by combining analytical modeling with morphological techniques. A geometric model was derived to determine the function of the uncinate processes and relate their action to morphological differences associated with locomotor specializations. The model demonstrates that uncinates act as levers, which improve the mechanical advantage for the forward rotation of the dorsal ribs and therefore lowering of the sternum during respiration. The length of these processes is functionally important; longer uncinate processes increasing the mechanical advantage of the Mm. appendicocostales muscle during inspiration. Morphological studies of four bird species showed that the uncinate process increased the mechanical advantage by factors of 2–4. Using canonical variate analysis and analysis of variance we then examined the variation in skeletal parameters in birds with different primary modes of locomotion (non-specialists, walking and diving). Birds clustered together in distinct groups, indicating that uncinate length is more similar in birds that have the same functional constraint, i.e. specialization to a locomotor mode. Uncinate processes are short in walking birds, long in diving species and of intermediate length in non-specialist birds. These results demonstrate that differences in the breathing mechanics of birds may be linked to the morphological adaptations of the ribs and rib cage associated with different modes of locomotion.

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Key words: biomechanics, breathing mechanics, morphology, uncinate.

Introduction

Birds lack the muscular diaphragm of mammals (Brackenbury, 1972) and do not ventilate their lungs by expanding the lung itself, but through the bellows-like movement of air through the air sacs (Brackenbury, 1972; Brackenbury, 1973). Uncinate processes are bony projections that extend from the vertebral ribs of most extant birds (Fig. 1). In 1935, Zimmer postulated that the uncinate processes played some role during inspiration (Zimmer, 1935). Contemporary hypotheses have linked these processes with stiffening or strengthening the rib cage (Kardong, 1988; Walker and Liem, 1994), providing attachment sites for muscles stabilizing the shoulder (Hildebrand, 1982), or serving as an adaptation for flight (Welty and Baptista, 1988). Existing hypotheses on uncinate function appear to have been based on the general morphology of these structures rather than experimental analyses. However, recent electromyographic studies in the giant Canada goose confirmed Zimmer's hypothesis by demonstrating that these processes are integral component of the ventilatory mechanics of birds being involved in both inspiration and expiration (Codd et al., 2005). The processes are associated with fleshy parts of the Mm. intercostales externi, the Mm. appendicocostales that originates from the proximal edge of the uncinate and inserts onto the following vertebral rib (Shufeldt, 1890). The Mm. appendicocostales is active during inspiration in the giant Canada goose, suggesting the processes facilitate the craniad movement of the ribs, which would in turn move the sternum ventrally (Codd et al., 2005). The base of the uncinate processes serves as a brace for the insertions of the 'finger-like' projections of the M. externus obliquus abdominus that pull the sternum dorsally during expiration (Codd et al., 2005). Given that the processes provide attachment sites for these important respiratory muscles, any change in uncinate morphology may have a significant effect on ventilation. Here we develop a mathematical mechanical model to examine the mechanics of ventilation in birds. This model will then be used to determine the mechanical advantage of the uncinate process system for movements of the ribs and therefore sternum during respiration.

Extant birds are diverse and include species that specialise in running, walking, swimming, flying and diving. As with any animal, morphological alterations in birds are commonly associated with differences in locomotor mode (Tucker, 1993; Patak and Baldwin, 1993; Dyke and Rayner, 2001; Rayner and Couldrick, 2003; Zeffer and Norberg, 2003). Furthermore, variations in uncinate morphology have previously been

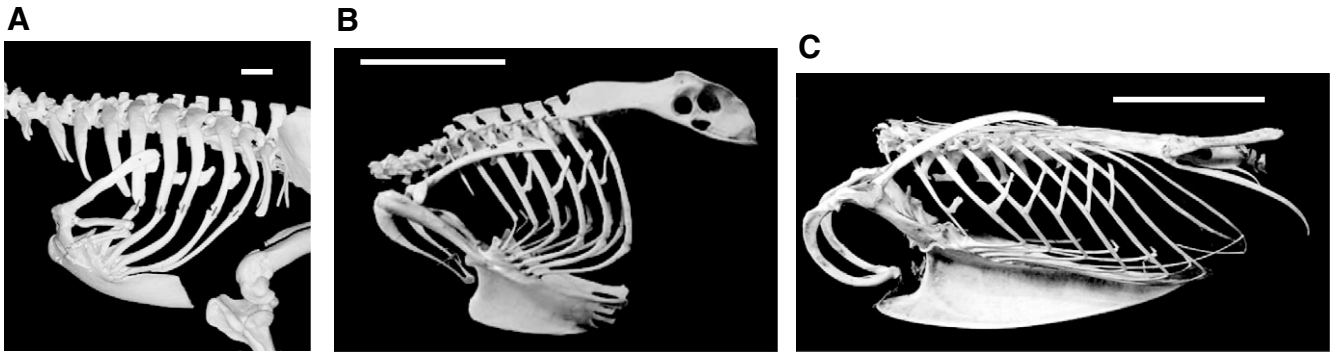

Fig. 1. Representative skeletons showing the morphological differences in the rib cage associated with different forms of locomotion in (A) a walking species, cassowary (*Casuaris casuaris*); (B) a non-specialist, eagle owl (*Bubo bubo*); and (C) a diving species, razorbill (*Alca torda*). Uncinate processes are short in walking species, of intermediate length in non-specialists and long in diving species. In all photographs cranial is to the left; scale bar, 5 cm.

anecdotally linked to differences in locomotor mode, and long uncinate processes noted in diving species (Welty, 1988; Duncker, 1971); however, there has been no further examination or testing of these observations. Here we use morphometric analysis to test the hypothesis that the length of the uncinate processes is predominantly correlated with the locomotor mode of birds. We will then use our mechanical model to examine the functional significance of these differences in uncinate length. In light of our mechanical model, a demonstrable link between the locomotor mode and the length of the uncinate processes will enable us to gain a better understanding of breathing mechanics in Aves.

The geometrical model of uncinate function

At a first approximation, the ribcage of a bird can be considered to be composed of two sets of dorsal and ventral ribs, which are held the same distance apart at the backbone and sternum, and at the same angle. Hence the dorsal and ventral ribs can be regarded as mirror images, which are separated where they join by the same distance as at the backbone and sternum. Therefore two adjacent dorsal ribs can be modeled as the opposite sides of a parallelogram (Fig. 2), running at an angle θ to the backbone and separated from each other by a distance *D*. Moving such a mechanism is clearly very different from rotating a single bone about a single joint. Any muscle can only alter the angle θ of the ribs to the backbone, and its mechanical advantage is best described by determining how much it changes in length for a given change in the rib angle; the bigger the length change, the more powerful its action and the greater its mechanical advantage.

Consider the effect of a muscle that joins the two ribs, and which is attached to the posterior rib a distance *P* further from the backbone than it is to the anterior rib (Fig. 2A). The length of the muscle, *L*, can be readily determined by Pythagoras's theorem:

$$L = x^2 + y^2 = \sqrt{[(D\cos\theta+P)^2 + (D\sin\theta)^2]} \,. \qquad (1)$$

For the Mm. intercostalis externus, which attaches the same distance down the ribs, *P* equals zero and the muscle runs

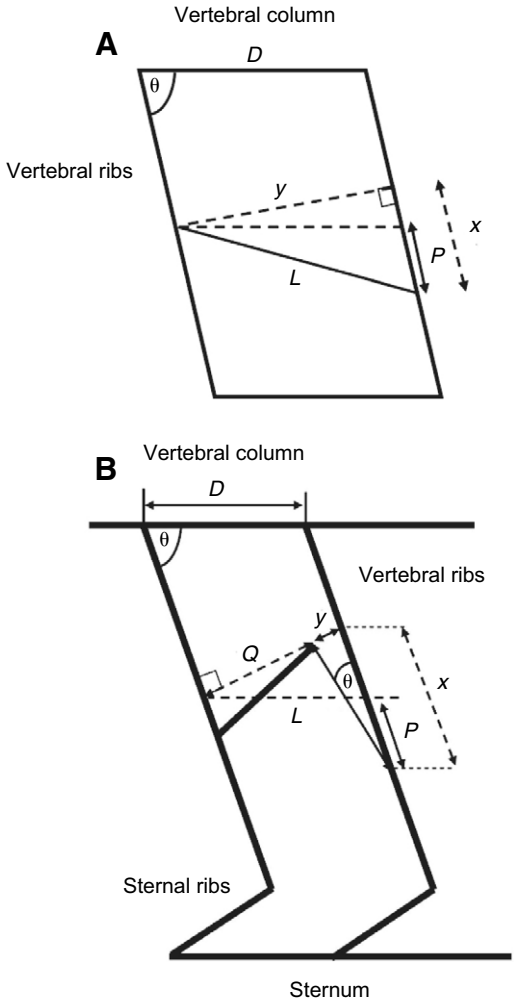

Fig. 2. Geometric model of uncinate function. (A) The situation in birds without an uncinate process. The length of the Mm. appendicocostales, *L*, changes with the rib angle, θ, depending on the distance down the rib, *P*, of the posterior attachment. (B) The situation with an uncinate process of perpendicular length *Q* behind the anterior rib. Cranial is to the left.

approximately parallel to the backbone. Its length is therefore given by the simplified equation:

$$L = \sqrt{[(D\cos\theta)^2 + (D\sin\theta)^2]} = D \, . \quad (2)$$

Whatever the angle of the ribs, the muscle length is constant. It cannot therefore act to move the ribs. The mechanical model supports previous experimental work (Codd et al., 2005), which demonstrated that the Mm. intercostalis externus had no activity related to either inspiration or expiration but was active during contralateral limb support, suggesting it plays a role acting as a brace to stabilise the thorax during locomotion (Codd et al., 2005).

For the appendicocostales muscle, however, for which P is positive, the length of the muscle will vary with the angle of the ribs according to the modified version of Eqn 1.

$$L = \sqrt{[D^2+P^2+2DP\cos\theta)]} \, . \quad (3)$$

The muscle will shorten as θ increases, so the appendicostales muscle will act to swing the ribs forward. Two examples of how the muscle's length will vary with θ are shown in Fig. 3A for P=0.5D and P=D. It can be seen that the length changes more rapidly with θ for larger values of P (the higher the angle of the muscle to the backbone) and at higher values of θ (the higher the angle of the ribs to the backbone). Therefore the mechanical advantage of the muscle will alter with both P and θ. Mechanical advantage (MA) is defined as the relative change in muscle length per unit change in angle and is given by the formula:

$$\mathrm{MA} = L_\theta - L_{\theta+1} / L_\theta \, . \quad (4)$$

The mechanical advantage is shown in Fig. 3A. It rises with the rib angle, θ, and is higher for larger values of P.

Effect of the uncinate process

Consider now the same ribcage, but with an uncinate process on the anterior rib that extends back a perpendicular distance, Q, from it, and that has the Mm. appendicocostales attached to its end (Fig. 2B). The length of this muscle is now given by the expression:

$$L = \sqrt{[(D\cos\theta+P)^2 + (D\sin\theta-Q)^2]} \, . \quad (5)$$

The effect of the uncinate process is to increase the length change of the muscle as the ribs are moved, because although as θ rises the reduction in the distance x parallel to the ribs (Dcosθ+P) is unaffected, the increase in the distance perpendicular y to the ribs (Dsinθ–Q) is reduced. Indeed if Q is sufficiently large that the uncinate process extends behind the posterior rib, swinging the ribs forward will actually reduce the perpendicular distance. The effect of uncinate processes of length Q=0.5D and Q=D on the length of the appendicocostales at different angles are shown in Fig. 3A, and the mechanical advantage at different angles is shown in Fig. 3B. It can be seen that the change in muscle length and the mechanical advantage of the muscle is greatly increased by the uncinate process, giving a good mechanical advantage even at low values of θ. The uncinate acts as a mechanical lever, being most effective when it is longer and, surprisingly, when P is smaller.

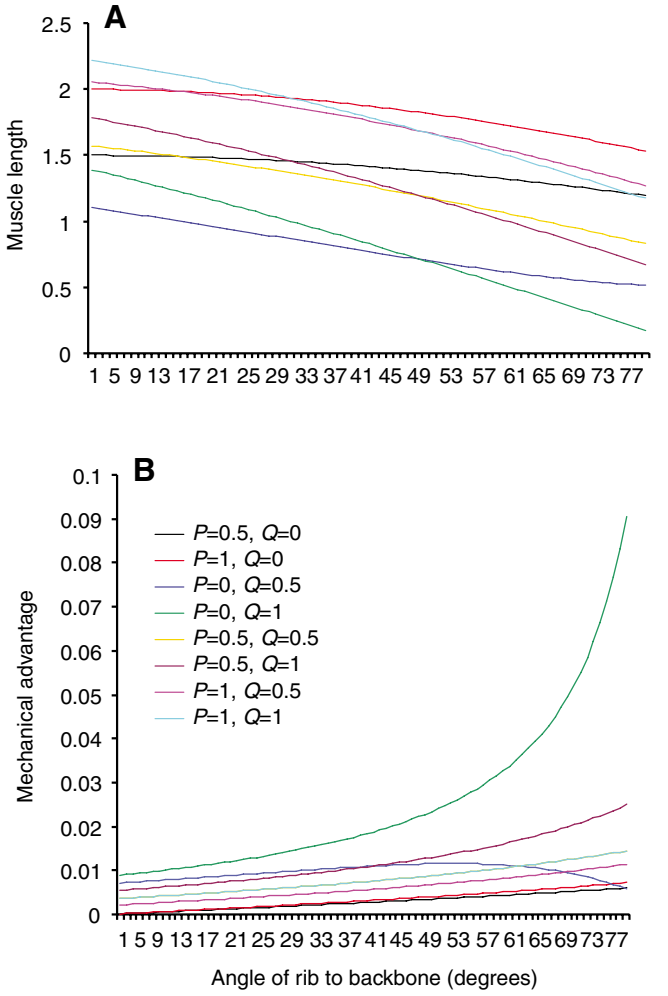

Fig. 3. (A) Changes in length of the Mm. appendicocostales muscle with rib angle, θ, for various relative values of uncinate length, Q, and distance of posterior attachment, P. (B) Changes in mechanical advantage of the Mm. appendicocostales muscle with rib angle, θ, for various relative values of uncinate length, Q, and distance of posterior attachment, P. It can be seen that mechanical advantage increases with θ, and with higher values of Q.

Materials and methods

Mechanical advantage of the Mm. appendicocostales

The uncinate length, Q, the distance between the ribs, D, the distance of the posterior insertion, P, and the rib angle θ of the ribs were measured in four randomly chosen representative bird species: the diving razorbill *Alca torda* L.; the non-specialist locomotors kestrel *Falco tinnunculus* L. and barnacle goose *Branta leucopsis* Bechstein 1803; and the walking red-legged partridge *Alectoris rufa* L.

All lengths were measured on the left hand side of the skeleton using a digital caliper (16EX 150 mm, Product No: 4102400, Mayr GmbH, Berlin, Germany), while the angle was measured using an image analysis system of digital images. Using our mechanical model (Eqn 4), we then calculated the mechanical advantage for each appendicocostales muscle, with and without the uncinate processes.

Skeletal morphology

Data were collected from the skeletons of 100 birds representing examples from all major taxa and orders (see Appendix in supplementary material). To establish if within-species variation in uncinate process length on different ribs was significantly different, the lengths of the processes from ten skeletons of adult barnacle geese *Branta leucopsis* were examined. Birds were then grouped according to specialization to a primary mode of locomotion. (1) Walking, including birds that are either flightless (e.g. cassowary) or incapable of sustained flight (e.g. capercallie); (2) diving, including all birds that actively forage under water by either plunge (e.g. kingfisher) or sustained, deep diving (penguin); and (3) non-specialists, including all other birds flying or swimming that are not facultative diving or walking birds. We collected measurements of the length of the vertebral and sternal ribs, and the length and width of the uncinate processes. Sternal morphology was also examined by measuring the total length and depth of the sternum (height of keel). Correcting for body size is problematic in birds as many species have disproportionably long necks, meaning the traditional snout–vent measurements to scale for size are not feasible. Therefore all data collected were corrected for variations in body size by dividing total length by the length of the vertebral column spanning the thoracic ribs. All data were collected from the left hand side of the skeleton using a Mayr digital caliper (16EX 150 mm, Product No: 4102400, Mayr GmbH).

Statistical analysis

Relationships between the groups were determined using canonical variate analysis (CVA), which maximises the variation between groups relative to the variation within groups (Campbell and Atchley, 1981). Values used in the CVA were: uncinate length and width at base, midpoint and tip; sternal width, length and depth; vertebral and sternal rib length. A one-way ANOVA with a Tukey *post-hoc* test was used to establish if mean uncinate length varies according to mode of locomotion. Within-species uncinate comparison and the ratio of sternal length to depth were analysed using a repeated-measures ANOVA with Bonferroni comparisons. All analyses were completed using the statistical package SPSS (SPSS v.13.0; SPSS Ltd, Chicago, IL, USA).

Results

Mechanical advantage of the Mm. appendicocostales

Measurements on the four bird species were taken and analysed using our mathematical model, with or without the uncinate process. The results of the output from the model are given in Table 1 and Fig. 4. It can be seen that in each species without the uncinate processes the mechanical advantage of the Mm. appendicocostales was low, whereas the presence of uncinate processes improved the mechanical advantage for rib movements by a factor of 2–4. The model therefore demonstrates that uncinate processes act as levers for movements of the ribs (see Table 1, Fig. 4).

Rib cage morphology

Rib number does not always correlate with locomotor mode, although walking species generally tend to have the fewest ribs and the diving species the most. For birds used in this study, 8 had 6 ribs, 43 had 7 ribs, 25 had 8 ribs, 22 had 9 ribs and only 2 had 10 ribs (see Appendix in supplementary material). Our

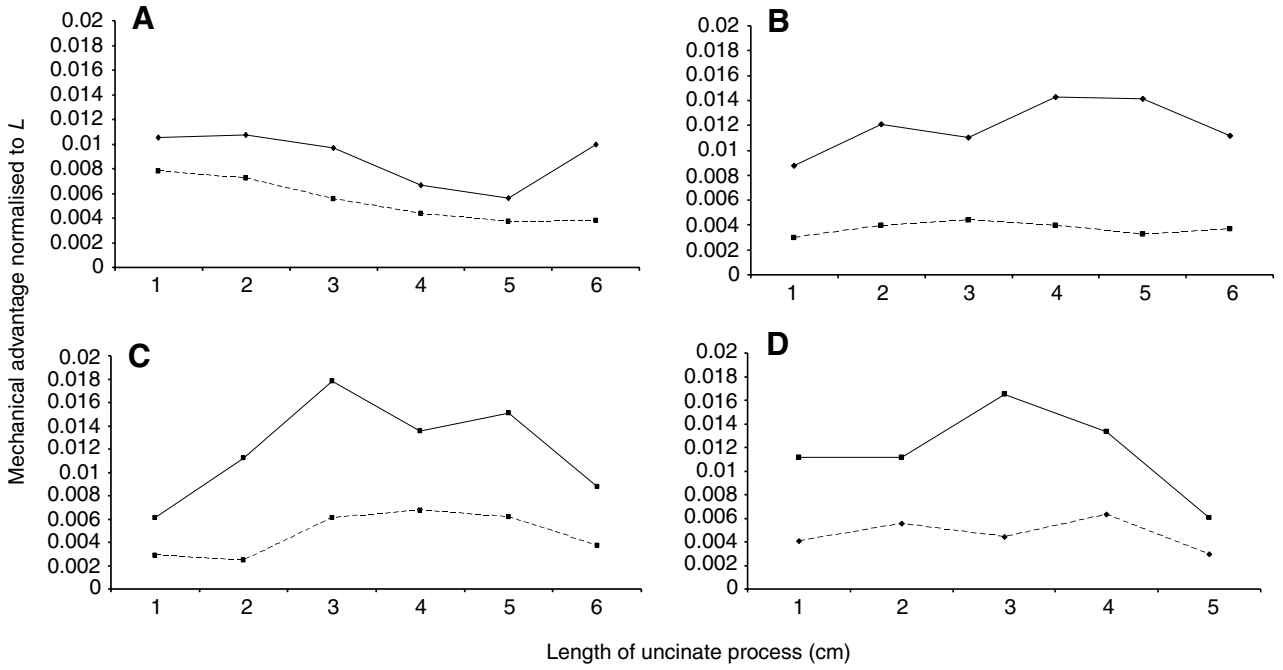

Fig. 4. Mechanical advantage (corrected for muscle length *L*) for representative species calculated with (solid line) and without (broken line) the uncinate processes. (A) A diving bird, the razorbill *Alca torda*; (B,C) non-specialist birds, (B) barnacle goose *Branta leucopsis* and (C) kestrel *Falco tinnunculus*; and a walking bird (D) the red-legged partridge *Alectoris rufa*.

Table 1. *Measurements of the uncinate process on the anterior rib that extends back a perpendicular distance (Q), the distance between the ribs (D), the distance of the posterior insertion (P) and the rib angle (θ) of the ribs in bird species representative of different types of locomotion*

	Barnacle goose	Razorbill	Kestrel	Red-legged partridge
D (mm)	14.9±0.59	7.94±0.44	7.51±1.57	7.6±1.99
P (mm)	4.54±0.43	13.08±1.29	3.79±1.91	3.81±1.13
Q (mm)	7.21±0.43	10.50±1.3	4.50±0.36	3.87±0.50
θ (degrees)	71.19±1.88	64.79±6.77	76.85±3.66	74.26±0.41

Species include the diving razorbill *Alca torda*; the non-specialists kestrel *Falco tinnunculus* and barnacle goose *Branta leucopsis*; and the walking red-legged partridge *Alectoris rufa.*

Values are means ± s.e.m. (*N*=6–10).

correction for body size will tend to make comparisons less different rather than more. The general morphology of the rib cage was similar in all birds examined, as indicated by a within-species comparison of relative uncinate process length (mean ± s.e.m.) for 10 barnacle geese *Branta leucopsis*. Aside from the first rib, sternal ribs connect the vertebral ribs to the sternum and these become increasingly thinner and longer as one moves down the vertebral column. Using one-way ANOVA and Tukey *post-hoc* tests the mean length (± s.e.m.) of the uncinate processes are significantly shorter on the first (0.16±0.02) and last (0.14±0.02) ribs on which they occur. Therefore data from these processes were not used in the canonical analysis. The processes on the remaining ribs are not significantly different in length (rib 2: 0.22±0.03; rib 3: 0.23±0.02; rib 4: 0.22±0.02; rib 5: 0.21±0.03). Therefore the mean length of processes 2–5 was used in all subsequent analyses.

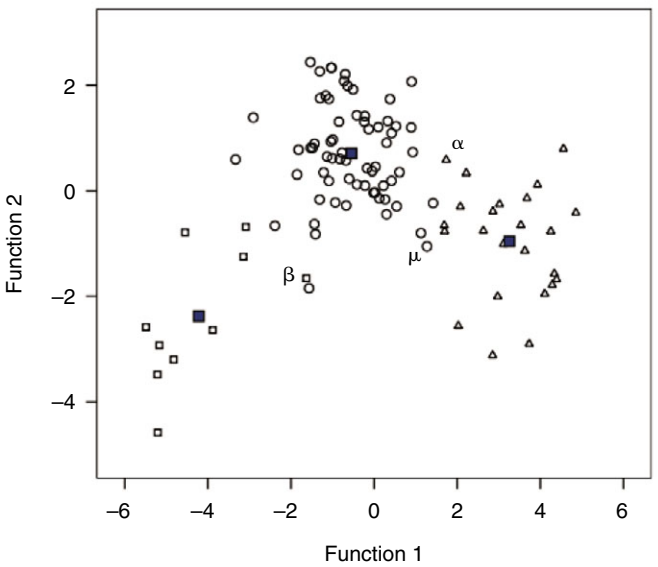

Fig. 5. Canonical variate analysis (CVA) of skeletal morphology in birds. Function 1 against function 2 for walking species (squares, *N*=10); non-specialists (circles, *N*=66); diving birds (triangles, *N*=24). Functions 1 and 2 were primarily functions of relative uncinate length and width and rib length, respectively. Solid black squares represent significantly different group centroids. Letters highlight borderline species of respective groups: the fulmar (α), the green woodpecker (β) and the swallow (μ).

Canonical variate analysis

There was distinct clustering in the data corresponding to locomotor mode and significant differences between group means (Wilks' Lambda=0.82, $P<0.001$, Fig. 5). Some overlap is present, indicating that there are species on the boundary of our classification. Canonical discriminant function 1 accounts for 80.2% of the variation while function 2 accounts for 19.8%. Functions 1 and 2 were primarily functions of relative uncinate length and width and rib length, respectively.

Uncinate morphology

The relative length of the uncinate processes was found to be more similar in birds with the same locomotor mode. They were shortest in the walking (0.11±0.02, *N*=10, $P<0.01$), of intermediate length in non-specialist (0.17±0.01, *N*=66, $P<0.01$) and the longest in diving species (0.23±0.01, *N*=24, $P<0.01$). The processes of the walking birds typically reach about halfway across to the following rib. In non-specialists the processes have a characteristic L-shaped morphology and reach across to the following rib. In diving species the uncinate processes are long, thin and taper towards the end (Fig. 1C), and may overlap the following rib. There is no significant difference between relative uncinate length in the deep (0.21±0.01, *N*=8) and shallow divers (0.19±0.02, *N*=16, $P=0.32$, two-sample *t*-test).

Sternal morphology

The relative ratio of sternal length to depth of walking birds was significantly lower (1.12±0.44, *N*=10, $P<0.001$) than that of non-specialist (2.16±0.07, *N*=66, $P<0.01$) and diving species (2.75±0.20, *N*=24, $P<0.01$).

Discussion

Role of the uncinate process

The mechanical model developed in this paper suggests that the uncinate process acts as a lever, increasing the mechanical advantage of the Mm. appendicocostales, particularly when the ribs are at a low angle to the backbone, helping them rotate the dorsal ribs forwards, pushing the sternum down, and so inflating the lungs. The results of actual mechanical advantage of the four representative species measured, based on the model, confirms this interpretation. In all cases the mechanical advantage increased by a factor of 2–4 compared with what it would have been had an uncinate process not been present, though the effect was least pronounced in the diving species, the razorbill.

These results can help shed light on the two main findings of the morphometric study: first that the anterior and posterior uncinates are shorter than the intermediate ones; and second that the uncinates and sternum of diving birds were relatively longer than those of walking birds, with non-specialist birds having uncinates and sternum of intermediate length. The sternum in birds is the site of attachment for the large flight muscle, the pectoralis and supracoracoideus (Duncker, 1971). The pectoralis can account for up to 35% of the body mass of some birds (Dial et al., 1988). This large muscle mass, together with the abdominal viscera, must be moved up and down during breathing (Brainerd, 1999). The importance of movements of the sternum is highlighted by the entrainment of wing beat with sternal movements (Jenkins et al., 1998) and the fact that birds can suffocate if movements of the sternum are restricted (Ludders et al., 2001). The uncinate processes also act as a brace for the insertion of the M. obliquus externus, which pulls the sternum dorsally to effect expiration (Codd et al., 2005), meaning there is a functional link between sternal and uncinate morphology and the breathing mechanics in birds. The sternum of walking birds is reduced and this group has the shortest length processes, while the elongated sternum of diving birds correlates with the longest length processes. Differences in uncinate morphology may translate into anatomical differences in the associated musculature such as the Mm. appendicocostales and M. obliquus externus, meaning that different patterns of muscle activity facilitate breathing; this, however, remains to be determined.

The Mm. appendicocostales attaches to the proximal edge of the process, meaning that the total length of the process is the most significant characteristic in uncinate morphology. The width of the process along its length may contribute to the overall strength. However, the process is rigidly fixed from above to the rib it extends from by a strong triangular aponeurotic membrane that is attached from the anterior edge of the process along its entire length (Shufeldt, 1890). This ligament provides a strong anchorage for the lever action on the ribs and may negate any thickening of the process itself. Aside from the walking birds, the uncinate processes are also typically thin and taper towards the tip of the process. Alterations in uncinate length may also have implications for the area available for muscle insertion, given the role of the processes during expiration, as thickening of the base would increase the area for attachment for the insertion of the M. obliquus externus (Codd et al., 2005). In all birds examined the anterior and posterior uncinates are siginficantly shorter than the remaining processes. Aside from the diving species, the mechanical advantage for the anterior and posterior processes is also correspondingly lower, suggesting these processes and their associated muscles probably have little function in moving the ribcage during breathing.

Determination of locomotor modes

The locomotor modes used in the morphometric study are broadly defined into walking, diving and non-specialist birds. Although within each group there remain potentially significant differences between the birds, i.e. foot and wing propelled divers, these modes can be considered to be representative as there are broad mechanical differences between specialization for running *versus* diving and/or non-specialists (all other birds). Swimming birds were not categorized as a separate grouping as there are no birds that swim but do not fly. The results of the CVA analysis indicate that there are species that overlap or are near the border of the locomotor groups. These species represent birds that have intermediate morphology; for example, the fulmar (Fig. 5α), which is classed as a diving species, is a strong flyer, which may explain why it borders the non-specialist group. The green woodpecker (Fig. 5β), which clusters close to the walking species, can be considered an atypical bird as it has pronounced broadening of the vertebral ribs as an adaptation to head banging (Kirby, 1980). Swallows (Fig. 5μ) have highly streamlined bodies, which may explain why they cluster close to the diving species.

Contrast in uncinate morphology between diving and walking species

Longer processes have previously been assumed to play a role in preventing collapse of the rib cage by counteracting the increased pressure with increased depth during dives (Welty, 1988). However, aside from the penguins (*Aptendytes patagonicus*, *Spheniscus demersus* and *S. humbolti*) and auks (*Pinguinis impennis*, *Alca torda* and *Alle alle*), the vast majority of diving birds investigated in this study do not dive to depths likely to encounter large increases in pressure. Species from diverse groups such as the kingfisher (*Alcedo atthis*), the white throated dipper (*Cinclus cinclus)*, the gulls (*Larus argentatus* and *L. canus*), the ducks (*Clangula hyemalis* and *Mergus merganser*) and the terns (*Sterna paradisaea* and *S. hirundo*) have nominal diving depths of less than 10 m; i.e. approximately 1 atmosphere of pressure (Jones and Furilla, 1987). Despite this, there is no significant difference between uncinate length in the deep and shallow divers; all diving birds have significantly longer uncinates than the non-specialist and walking birds (see Appendix in supplementary material). Any muscle pulling on the uncinate processes will facilitate movement of the associated rib rather than prevent it. Furthermore, given that the uncinate processes are not found on every rib, it seems unlikely that they are essential in stiffening the body cavity against increased pressure. The caudally located thin and long ribs, i.e. those that would need the most stiffening as pressure increased on the rib cage, lack uncinates (Fig. 1C). Diving birds have a streamlined body form, long ribs and sternum, to reduce resistance on entry to the water. In diving birds the greater relative length of the uncinate processes is probably related to the greater length of the sternum and the lower angle of the ribs to the backbone and sternum (Fig. 1C). As indicated by our model, without an uncinate process the mechanical advantage of the Mm. appendicocostales in lowering the sternum is low, while the force needed to lower the sternum against the large pectoralis muscle in these species would be extremely high. Interestingly, in the razorbill the effectiveness of the uncinate process at increasing the mechanical advantage was actually rather low. This is probably due to the large angle between the ribs and the vertebral column in this species, which may make the uncinate less important, but it contrasts strongly with the low angle seen in its relative the guillemot (J.R.C., unpublished observations). During surfacing both penguins (Wilson et al., 2003) and tufted ducks (Parkes et al., 2002)

maximise gas exchange by increasing breathing frequency. The increased mechanical advantage of longer uncinates may be especially important upon resurfacing when inspiration occurs against the pressure of water against the body. In walking birds, in contrast, the sternum is relatively small (Fig. 1A) and the ribs are at a large angle to the backbone and sternum (Fig. 2A). Even without an uncinate process the appendicocostales muscle could have a reasonable mechanical advantage, and little force needs to be exerted against the tiny pectoralis muscle. In any case the dorsal and ventral ribs tend towards being parallel, meaning that rotating the dorsal rib forward would have little effect in increasing the volume of the chest cavity.

Conclusion

The morphology of the rib cage and the length of the uncinate processes varies with locomotor mode. The reduction in uncinate length found in the walking species suggests that they may play a reduced role during breathing in these species, meaning muscles such as the Mm. intercostalis externi may play a significant role during inspiration in walking birds; this, however, remains to be determined. The elongation of the ribs, rib cage and sternum associated with streamlining in diving species suggests that differences may also exist in their breathing mechanics. Given the increased length of the processes in diving birds, the insertion of the Mm. appendicocostales towards the end of the tip of the processes may further improve the mechanical advantage for moving the elongated ribs during breathing. Future work may improve our understanding of anatomical differences in musculature associated with variations in uncinate morphology. Alternative functions of the uncinate processes remain to be determined; for example, the role of the uncinate processes in stabilizing the scapula during retraction of the wing has not been examined here. Additionally the 'finger-like' projections of the M. obliquus externus abdominus insert onto the base of the processes, and in the opposite manner the M. serratus superficialis originates at the top of the processes and inserts on the ventral margin of the scapula (Vanden Berge and Zweers, 1993), suggesting that they may act antagonistically. Variations in uncinate morphology seem likely to relate to differences in the muscles involved in breathing or in the pattern of muscle activity. Respiration in Aves is complex, with a great many axial muscles reported to be involved (Fedde, 1987). This research suggests that there may be fundamental differences in the breathing mechanics of different birds, driven in part by the morphological differences of the rib cage and sternum associated with skeletal adaptations to locomotion.

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Name		Locomotor Mode	No of Ribs	Rib 2 Dorsal Rib Length to UCP	Rib 3 Dorsal Rib Length to UCP	Rib 4 Dorsal Rib Length to UCP
Fulica	americana	**diving**	9	21.55	23.74	25.05
Gavia	arctica	**diving**	9	55.66	60.57	62.76
Fulica	atra	**diving**	9	24.29	28.15	31.31
Larus	canus	**diving**	7	24.77	23.18	21.53
Alcedo	atthis	**diving**	7	10.98	12.26	11.59
Mergus	merganser	**diving**	9	35.45	37.85	36.43
Spheniscus	demersus	**diving**	9	51.36	57.31	58.05
Sterna	hirundo	**diving**	8	19.3	20.2	19.45
Pinguinus	impennis	**diving**	10	33.72	40.51	42.61
Spheniscus	humboldti	**diving**	7	51.4	52.72	51.99
Larus	argentatus	**diving**	7	40.08	36.97	35.4
Alle	alle	**diving**	9	21.29	23.41	22.5
Clangula	hyemalis	**diving**	7	33.29	33.61	31
Gavia	stellata	**diving**	8	42.01	42.75	41.93
Pelecanus	rufescens	**diving**	6	72.94	69.36	64.23
Aptenodytes	patagonicus	**diving**	8	84.97	91.55	92.88
Fumarus	glacialis	**diving**	8	31.74	33.68	32.9
Alca	torda	**diving**	9	31.54	35.47	36.6
Aythya	fuligula	**diving**	9	24.53	25.51	26.29
Cinclus	cinclus	**diving**	7	12.75	14.45	14.94
Sterna	paradisaea	**diving**	8	17.5	17.42	16.94
Phalacrocorax	carbo	**diving**	8	37.6	40.83	40.23
Phalacrocorax	bougainvillii	**diving**	7	41.98	42.6	39.05
Podiceps	cristatus	**diving**	9	30.65	32.33	33.78
Tockus	nasutus	**non-specialist**	8	18.74	19.66	19.21
Hirundo	rustica	**non-specialist**	7	7.48	7.84	8.22
Gypaetus	barbatus	**non-specialist**	7	54.71	60.06	61.93
Turdus	merula	**non-specialist**	7	13.53	14.6	14.6
Eremopterix	leucotis	**non-specialist**	7	6.74	7.2	7.26
Elanus	caerulus	**non-specialist**	7	17.82	17.01	18.19
Amazona	aestiva	**non-specialist**	8	20.76	22.6	21.49
Columba	bollii	**non-specialist**	7	15.5	18.46	20.46
Melopsittacus	undulatus	**non-specialist**	8	8.54	9.79	9.8
Streptopelia	decaocto	**non-specialist**	7	12.56	15.52	17.23

Name		Locomotor Mode	No of Ribs	Rib 2 Dorsal Rib Length to UCP	Rib 3 Dorsal Rib Length to UCP	Rib 4 Dorsal Rib Length to UCP
Columba	cayennensis	**non-specialist**	7	17.38	19.03	20.45
Corvus	corax	**non-specialist**	6	35.44	34.05	33.06
Passer	domesticus	**non-specialist**	7	7.73	8.98	8.77
Apus	apus	**non-specialist**	8	8.19	9.37	9.94
Vultur	gryphus	**non-specialist**	8	0	60.29	63.17
Chrysococcyx	caprius	**non-specialist**	7	7.83	9.02	8.67
Bubo	bubo	**non-specialist**	7	38.94	39.79	42.72
Sturnus	vulgaris	**non-specialist**	7	12.12	12.96	13.16
Agapornis	fischeri	**non-specialist**	8	9.32	9.97	9.97
Aquila	chrysaetus	**non-specialist**	8	41.02	44.5	36.94
Picoides	viridis	**non-specialist**	7	13.81	15.77	15.69
Buceros	bicornis	**non-specialist**	7	44.22	48.07	46.02
Psittacus	erithacus	**non-specialist**	8	23.44	25.77	29.32
Falco	rusticolus	**non-specialist**	8	32.01	37.52	39.37
Loriculus	galgulus	**non-specialist**	8	7.81	9.73	10
Chlamydotis	undulata	**non-specialist**	7	38.53	38.16	37.12
Phaethornis	yaruqui	**non-specialist**	7	6.29	7.14	6.61
Falco	biarmicus	**non-specialist**	8	26.83	26.75	27.43
Chordeiles	acutipennis	**non-specialist**	7	0	9.89	11.59
Athene	noctua	**non-specialist**	7	17.94	17.95	18.05
Bubo	ascalaphus	**non-specialist**	7	33.17	37.54	38.7
Agapornis	roseicollis	**non-specialist**	7	10.59	11.38	11.38
Mimus	polyglottos	**non-specialist**	7	5.59	5.88	5.73
Oena	capensis	**non-specialist**	7	8.52	10.39	10.39
Trichoglossus	haematodus	**non-specialist**	8	13.65	14.26	15.35
Chrysolampis	mosquitus	**non-specialist**	8	5.32	5.98	6.49
Polytelis	swainsonii	**non-specialist**	8	16.74	18.01	19.02
Ramphastos	tucanus	**non-specialist**	7	23.11	22.02	22.79
Colius	colius	**non-specialist**	7	10.25	11.29	12.27
Trogon	viridis	**non-specialist**	7	13.44	15.43	16.59
Rostratula	semicollaris	**non-specialist**	8	17.38	19.03	20.45
Perdix	perdix	**non-specialist**	7	13.21	12.49	13.68
Phoenicopterus	rubur	**non-specialist**	7	54.02	51.86	54.61
Botaurus	stellaris	**non-specialist**	7	45.23	48.12	49

Name		Locomotor Mode	No of Ribs	Rib 2 Dorsal Rib Length to UCP	Rib 3 Dorsal Rib Length to UCP	Rib 4 Dorsal Rib Length to UCP
Francolinus	pondicerianus	**non-specialist**	7	10.2	10.86	11.67
Ardea	alba	**non-specialist**	6	40.64	39.28	36.38
Tetraogallus	himalayensis	**non-specialist**	6	27.94	29.36	29.97
Thinocorus	rumicovorus	**non-specialist**	8	11.17	13.21	13.43
Aramus	guarauna	**non-specialist**	8	0	27.52	30.21
Ixobrychus	minutus	**non-specialist**	7	16.85	18.51	20.19
Leptoptilos	crumeniferus	**non-specialist**	6	0	47.53	56.32
Pterocles	exustus	**non-specialist**	7	14.84	15.69	16.48
Sagittarius	serpentarius	**non-specialist**	7	0	45.85	47.35
Platalea	leucorodia	**non-specialist**	7	31.13	34.15	34.36
Scolopax	rusticola	**non-specialist**	9	0	18.47	19.66
Branta	leucopsis	**non-specialist**	9	36.81	36.84	4.08
Cygnus	atratus	**non-specialist**	9	0	62.05	63.36
Somateria	mollissima	**non-specialist**	9	35.66	37.48	39.6
Anas	falcata	**non-specialist**	9	23.45	27.02	27.33
Aythya	marila	**non-specialist**	9	25.25	29.61	28.82
Gallinula	chloropus	**non-specialist**	9	18.32	19.66	21.41
Anas	acuta	**non-specialist**	9	25.22	26.2	29.9
Tadorna	ferruginea	**non-specialist**	9	24.49	27.86	28.9
Tadorna	tadorna	**non-specialist**	9	27.67	29.34	31.01
Anser	albifrons	**non-specialist**	9	34.99	37.31	35.11
Falco	tinnuculus	**non-specialist**	8	13.81	15.48	16.09
Tetrao	urogallus	**walking**	6	24.34	28.9	31.92
Casuarius	casuarius	**walking**	10	0	0	102.62
Apteryx	haastii	**walking**	8	35.49	40.91	40.91
Dinornis	maximus	**walking**	9	124.06	130.75	152.53
Struthio	camelus	**walking**	9	0	180.91	182.75
Phasianus	colchicus	**walking**	7	17.21	18.46	19.25
Geococcyx	californianus	**walking**	6	12.58	17.8	21.27
Eudromia	elegans	**walking**	7	19.84	20.93	21.09
Meleagris	gallopavo	**walking**	6	20.31	22.93	25.04
Alectoris	rufa	**walking**	7	15.24	15.72	16.77

Name		Rib 5 Dorsal Rib Length to UCP	Rib 6 Dorsal Rib Length to UCP	Rib 2 Width of Uncinate at base	Rib 3 Width of Uncinate at base
Fulica	americana	25.6	26.37	1.63	2.14
Gavia	arctica	65.91	63.61	5.81	6.35
Fulica	atra	34.11	32.41	2.28	2.58
Larus	canus	22.67	0	2.22	2.26
Alcedo	atthis	10.71	0	1.46	1.32
Mergus	merganser	34.68	28.67	2.19	3.98
Spheniscus	demersus	58.51	57.21	5.91	6.81
Sterna	hirundo	18.62	17.47	1.46	2.06
Pinguinus	impennis	45.22	43.32	2.12	1.31
Spheniscus	humboldti	49.53	43.44	6.33	4.09
Larus	argentatus	33.78	0	4.23	3.69
Alle	alle	21.68	21.14	1.73	1.45
Clangula	hyemalis	28.24	23.66	2.81	3.47
Gavia	stellata	39	34.5	4.78	5.47
Pelecanus	rufescens	60.95	0	6.68	5.99
Aptenodytes	patagonicus	89.01	81.12	8.29	9.57
Fumarus	glacialis	32.26	32.54	2.13	3.08
Alca	torda	37.54	36.48	3.21	2.2
Aythya	fuligula	26.29	21.55	2.52	3.29
Cinclus	cinclus	14.94	12.77	1.41	1.54
Sterna	paradisaea	15.17	14.57	1.32	1.68
Phalacrocorax	carbo	39.37	36.82	4.3	4.13
Phalacrocorax	bougainvillii	43.29	39.2	4.89	5.22
Podiceps	cristatus	35.53	32.8	2.78	3.33
Tockus	nasutus	19.92	19.5	3.59	2.55
Hirundo	rustica	8.01	0	0.78	0.69
Gypaetus	barbatus	58.58	51.83	5.44	16.77
Turdus	merula	14.98	13.01	1.33	1.27
Eremopterix	leucotis	7.08	7.08	0.65	0.99
Elanus	caerulus	15.83	14.65	4.59	5.76
Amazona	aestiva	21.95	22.94	4.28	5.23
Columba	bollii	20.49	20.47	2.22	3.46
Melopsittacus	undulatus	10.15	9.68	1.68	2.64
Streptopelia	decaocto	16.68	16.68	1.9	3.04

Name		Rib 5 Dorsal Rib Length to UCP	Rib 6 Dorsal Rib Length to UCP	Rib 2 Width of Uncinate at base	Rib 3 Width of Uncinate at base
Columba	cayennensis	19.27	16.91	3.96	6.26
Corvus	corax	31.14	0	6.24	5.95
Passer	domesticus	8.55	8.05	0.74	0.77
Apus	apus	10.05	9.81	0.64	0.8
Vultur	gryphus	59.54	49.87	0	10.41
Chrysococcyx	caprius	8.36	0	0.88	1.03
Bubo	bubo	42.9	41.43	4.2	4.54
Sturnus	vulgaris	12.4	11.42	1.15	1.29
Agapornis	fischeri	9.03	8.76	1.75	1.9
Aquila	chrysaetus	39.35	34.63	11.11	14.31
Picoides	viridis	14.43	0	3.42	4.08
Buceros	bicornis	41.04	0	5.16	5.86
Psittacus	erithacus	27.31	23.96	2.48	4.55
Falco	rusticolus	37.61	33.82	3.14	4.77
Loriculus	galgulus	9.59	8.59	0	0.84
Chlamydotis	undulata	37.45	38.7	5.83	11.38
Phaethornis	yaruqui	6.62	0	0.61	0.55
Falco	biarmicus	25.43	25.49	3.17	5.92
Chordeiles	acutipennis	12.12	11.42	0	0.91
Athene	noctua	17.78	0	1.75	1.77
Bubo	ascalaphus	38.74	0	4.4	5.02
Agapornis	roseicollis	11.13	11.42	2.2	2.45
Mimus	polyglottos	5.38	4.21	0.45	0.48
Oena	capensis	10.39	9.52	0.78	1.89
Trichoglossus	haematodus	15.35	13.36	2.05	3.42
Chrysolampis	mosquitus	6.68	6.99	0.5	0.41
Polytelis	swainsonii	18.48	19.77	1.03	2.24
Ramphastos	tucanus	24	20.4	3.52	3.47
Colius	colius	12.55	9.91	1.52	2.19
Trogon	viridis	16.23	0	1.51	1.7
Rostratula	semicollaris	19.27	16.91	3.96	6.26
Perdix	perdix	13.37	12.85	1.38	1.5
Phoenicopterus	rubur	46.49	42.19	9.79	6.23
Botaurus	stellaris	47.22	43.22	2.49	1.78

Name		Rib 5 Dorsal Rib Length to UCP	Rib 6 Dorsal Rib Length to UCP	Rib 2 Width of Uncinate at base	Rib 3 Width of Uncinate at base
Francolinus	pondicerianus	12.65	12.33	1.29	1.13
Ardea	alba	35.8	0	3.73	3.36
Tetraogallus	himalayensis	30.15	0	3.14	3.71
Thinocorus	rumicovorus	14.67	13.91	0	0.91
Aramus	guarauna	30.31	29.42	0	1.53
Ixobrychus	minutus	15.52	0	0.83	1.29
Leptoptilos	crumeniferus	51.28	0	0	7.44
Pterocles	exustus	16.09	15.3	1.78	2.51
Sagittarius	serpentarius	41.03	37.46	0	10.06
Platalea	leucorodia	30.3	0	4.08	4.46
Scolopax	rusticola	15.51	16.03	0	1.75
Branta	leucopsis	34.81	31.22	2.98	2.97
Cygnus	atratus	58.41	50.13	0	7
Somateria	mollissima	40.5	36.23	2.95	3.45
Anas	falcata	26.68	22.49	1.78	1.68
Aythya	marila	27.52	25.4	3.66	4.11
Gallinula	chloropus	21.04	20.14	2.39	2.15
Anas	acuta	24.33	23.54	3.1	3.32
Tadorna	ferruginea	27.78	25.55	1.9	2.32
Tadorna	tadorna	27.6	26.83	1.81	6.27
Anser	albifrons	32.42	29.53	6.36	7.41
Falco	tinnuculus	16.03	16.37	3.75	4.23
Tetrao	urogallus	34.49	36.94	1.89	2.84
Casuarius	casuarius	105.5	96.16	0	0
Apteryx	haastii	40.57	35.34	15.48	12.35
Dinornis	maximus	163.15	172.12	5.05	23.79
Struthio	camelus	169.67	0	0	16.34
Phasianus	colchicus	20.21	0	2.37	2.46
Geococcyx	californianus	22.41	0	1.94	2.95
Eudromia	elegans	21.95	0	1.54	2.41
Meleagris	gallopavo	25.83	22.03	2.5	3.12
Alectoris	rufa	16.95	18.98	1.78	1.9

Name		Rib 4 Width of Uncinate at base	Rib 5 Width of Uncinate at base	Rib 6 Width of Uncinate at base	Rib 2 Width of Uncinate at Midpoint
Fulica	americana	1.87	1.82	1.75	1.33
Gavia	arctica	6.01	5.19	5	4.3
Fulica	atra	3.04	1.77	1	1.7
Larus	canus	1.94	1.61	0	1.8
Alcedo	atthis	1.23	2.1	0	1.54
Mergus	merganser	3.44	6.3	5.46	2.24
Spheniscus	demersus	5.85	4.78	3.52	6.29
Sterna	hirundo	1.73	1.73	1.42	1.02
Pinguinus	impennis	1.33	1.12	1.27	1.86
Spheniscus	humboldti	4.16	2.37	4.11	6.15
Larus	argentatus	2.36	1.79	0	2.47
Alle	alle	1.39	1.21	0.68	0.96
Clangula	hyemalis	2.7	1.62	1.29	2.51
Gavia	stellata	6.71	6.85	2.32	2.65
Pelecanus	rufescens	6.41	5.38	0	4.25
Aptenodytes	patagonicus	13.88	10.12	8.19	8.36
Fumarus	glacialis	2.64	2.67	2.53	1.62
Alca	torda	1.98	1.97	1.42	1.89
Aythya	fuligula	3.86	3.23	2.78	2.39
Cinclus	cinclus	1.01	0.71	0.47	0.92
Sterna	paradisaea	1.3	1.02	0.83	1.09
Phalacrocorax	carbo	4.35	3.2	3.74	3.85
Phalacrocorax	bougainvillii	3.66	4.59	3.73	5.18
Podiceps	cristatus	3.03	3.4	3	2.31
Tockus	nasutus	1.82	1.1	1.1	1.71
Hirundo	rustica	0.71	0.9	0	0.62
Gypaetus	barbatus	23.85	23.77	16.49	5.32
Turdus	merula	1.94	2.01	2.07	1.09
Eremopterix	leucotis	1.33	0.7	0.28	0.55
Elanus	caerulus	6.94	5.95	3.2	3.47
Amazona	aestiva	5.39	5.38	4.28	2.67
Columba	bollii	5.35	5.62	4.48	1.83
Melopsittacus	undulatus	2.32	2.11	0.7	1.22
Streptopelia	decaocto	3.62	3.61	3.66	1.61

Name		Rib 4 Width of Uncinate at base	Rib 5 Width of Uncinate at base	Rib 6 Width of Uncinate at base	Rib 2 Width of Uncinate at Midpoint
Columba	cayennensis	7.2	6.08	3.09	2.68
Corvus	corax	4.51	3.68	0	3.25
Passer	domesticus	0.99	0.92	0.56	0.83
Apus	apus	0.92	0.84	0.64	0.49
Vultur	gryphus	23.05	20.64	12.54	0
Chrysococcyx	caprius	0.88	0.88	0	0.73
Bubo	bubo	3.89	3.69	3.01	3.03
Sturnus	vulgaris	1.57	1.24	0.82	1.41
Agapornis	fischeri	1.44	1.23	0.8	1.15
Aquila	chrysaetus	17	19.58	19.57	5.37
Picoides	viridis	2.14	2.01	0	1.92
Buceros	bicornis	5.52	4.33	0	4.74
Psittacus	erithacus	6.87	8.25	2.91	2.47
Falco	rusticolus	4.84	6.21	5.88	2.89
Loriculus	galgulus	1.18	1	0.37	0.75
Chlamydotis	undulata	14.39	16	14.28	5.56
Phaethornis	yaruqui	0.58	0.59	0	0.33
Falco	biarmicus	6.18	6.17	7.29	2.4
Chordeiles	acutipennis	1.15	1.26	1.05	0
Athene	noctua	1.12	2.27	0	1.53
Bubo	ascalaphus	4.47	5.11	0	2.33
Agapornis	roseicollis	2.74	2.74	1.02	1.17
Mimus	polyglottos	0.49	0.4	0.27	0.32
Oena	capensis	2.42	2.28	1.24	0.82
Trichoglossus	haematodus	3.99	3.43	2.93	2.04
Chrysolampis	mosquitus	0.31	0.33	0.32	0.5
Polytelis	swainsonii	3.09	2.28	2.38	0.94
Ramphastos	tucanus	2.64	2.03	2.68	1.77
Colius	colius	3.2	2.51	2.32	1.23
Trogon	viridis	1.45	1.09	0	1.02
Rostratula	semicollaris	7.2	6.08	3.09	2.68
Perdix	perdix	2.19	2.03	1.8	1.41
Phoenicopterus	rubur	9.1	5.85	7.59	4.84
Botaurus	stellaris	2.32	1.71	1.31	2.12

Name		Rib 4 Width of Uncinate at base	Rib 5 Width of Uncinate at base	Rib 6 Width of Uncinate at base	Rib 2 Width of Uncinate at Midpoint
Francolinus	pondicerianus	0.96	0.99	0.93	1.03
Ardea	alba	3.93	3.56	0	3.34
Tetraogallus	himalayensis	3.75	3.6	0	2.53
Thinocorus	rumicovorus	0.94	0.96	0.77	0.65
Aramus	guarauna	1.64	2.19	1.34	0
Ixobrychus	minutus	1.01	0.45	0	0.72
Leptoptilos	crumeniferus	8.33	7.99	0	0
Pterocles	exustus	3.43	4.31	1.77	1.59
Sagittarius	serpentarius	16.64	30.48	22.14	0
Platalea	leucorodia	4.53	2.22	0	3.16
Scolopax	rusticola	2.13	1.77	2.07	0
Branta	leucopsis	2.52	4.11	4.07	2.29
Cygnus	atratus	6.44	6.21	6.91	0
Somateria	mollissima	3.69	3.75	5.32	3.02
Anas	falcata	2.32	2.37	3.13	1.41
Aythya	marila	5.55	5.08	4.33	2.97
Gallinula	chloropus	2.45	1.93	2.65	1.11
Anas	acuta	2.53	2.13	1.67	3
Tadorna	ferruginea	2.76	2.69	1.67	2.13
Tadorna	tadorna	2.98	3.76	4.15	1.67
Anser	albifrons	7.25	6.12	3.1	5.56
Falco	tinnuculus	4.35	3.9	3.97	1.36
Tetrao	urogallus	3.12	3.02	2.46	2.25
Casuarius	casuarius	15.65	17.33	17.08	0
Apteryx	haastii	13.79	13.79	19.44	6.38
Dinornis	maximus	28.46	25.89	26.06	19.4
Struthio	camelus	17.51	15.02	0	0
Phasianus	colchicus	2.5	3.25	0	1.94
Geococcyx	californianus	2.91	2.44	0	1.6
Eudromia	elegans	3.5	1.68	0	1.34
Meleagris	gallopavo	3.84	2.88	0	1.85
Alectoris	rufa	1.87	1.71	1.3	1.53

Name		Rib 3 Width of Uncinate at Midpoint	Rib 4 Width of Uncinate at Midpoint	Rib 5 Width of Uncinate at Midpoint	Rib 6 Width of Uncinate at Midpoint
Fulica	americana	1.47	1.93	1.52	1.59
Gavia	arctica	4.28	4.17	3.22	3.02
Fulica	atra	1.41	1.72	1.58	1.27
Larus	canus	1.8	2.12	1.23	0
Alcedo	atthis	1.31	1.04	1.34	0
Mergus	merganser	3.58	3.68	2.66	3.12
Spheniscus	demersus	6.23	6.17	6.5	8.07
Sterna	hirundo	1.23	1.26	1.13	1.07
Pinguinus	impennis	1.82	1.36	0.81	0.96
Spheniscus	humboldti	6.03	4.23	4.56	4.32
Larus	argentatus	2.22	1.82	1.2	0
Alle	alle	0.83	0.72	0.59	0.69
Clangula	hyemalis	2.44	2.03	1.05	0.77
Gavia	stellata	3.01	2.62	2.37	1.3
Pelecanus	rufescens	4.54	3.32	4.75	0
Aptenodytes	patagonicus	15.66	13.64	10.76	5.84
Fumarus	glacialis	2.02	1.71	2.12	2.13
Alca	torda	1.39	1.52	1.46	1.14
Aythya	fuligula	2.91	3.36	2.35	1.77
Cinclus	cinclus	1.3	1.03	1	0.65
Sterna	paradisaea	1.02	1.1	0.96	0.67
Phalacrocorax	carbo	3.04	2.78	2.26	1.67
Phalacrocorax	bougainvillii	4.68	4.75	2.75	2.05
Podiceps	cristatus	2.86	2.2	2.73	2.54
Tockus	nasutus	1.99	1.41	0.98	0.98
Hirundo	rustica	0.63	0.51	0.44	0
Gypaetus	barbatus	7.24	8.34	6.75	5.28
Turdus	merula	1.53	1.31	1.27	1.41
Eremopterix	leucotis	0.39	0.28	0.23	0.24
Elanus	caerulus	2.19	2.18	1.9	0.96
Amazona	aestiva	3.09	3.18	2.39	1.93
Columba	bollii	2.84	3.18	3.59	3.05
Melopsittacus	undulatus	1.21	1.26	1.05	0.65
Streptopelia	decaocto	2.58	2.3	2.52	2.22

Name		Rib 3 Width of Uncinate at Midpoint	Rib 4 Width of Uncinate at Midpoint	Rib 5 Width of Uncinate at Midpoint	Rib 6 Width of Uncinate at Midpoint
Columba	cayennensis	2.87	2.32	2.38	2.35
Corvus	corax	3.68	3.19	2.02	0
Passer	domesticus	0.86	0.71	0.55	0.52
Apus	apus	0.71	0.66	0.64	0.57
Vultur	gryphus	4.43	6.3	5.14	3.8
Chrysococcyx	caprius	0.83	0.64	0.64	0
Bubo	bubo	2.62	2.81	2.25	1.27
Sturnus	vulgaris	1.06	1	0.85	0.49
Agapornis	fischeri	0.9	0.88	0.77	0.7
Aquila	chrysaetus	4.88	5.18	5.75	5.43
Picoides	viridis	2.09	1.84	1.79	0
Buceros	bicornis	4.38	3.81	3.79	0
Psittacus	erithacus	2.73	3.92	4.11	2.78
Falco	rusticolus	2.79	2.15	2.25	1.8
Loriculus	galgulus	0.87	0.74	0.98	0.3
Chlamydotis	undulata	4.76	5.42	5.91	2
Phaethornis	yaruqui	0.56	0.4	0.4	0
Falco	biarmicus	3.07	2.4	3.05	2.83
Chordeiles	acutipennis	0.67	0.83	1.08	0.67
Athene	noctua	1.36	1.25	1.03	0
Bubo	ascalaphus	2.63	2.02	1.68	0
Agapornis	roseicollis	1.03	0.87	0.62	0.63
Mimus	polyglottos	0.54	0.32	0.26	0.26
Oena	capensis	1.49	1.36	0.98	1.15
Trichoglossus	haematodus	1.91	2.02	1.56	1.05
Chrysolampis	mosquitus	0.4	0.3	0.31	0.31
Polytelis	swainsonii	2.69	2.01	1.62	0.56
Ramphastos	tucanus	1.96	2.08	1.01	2.35
Colius	colius	1.38	1.46	1.54	1.33
Trogon	viridis	0.91	0.86	0.84	0
Rostratula	semicollaris	2.87	2.32	2.38	2.35
Perdix	perdix	1.38	1.54	1.34	1.65
Phoenicopterus	rubur	5.16	4.93	4.39	2.61
Botaurus	stellaris	2.09	1.93	2.2	2.09

Name		Rib 3 Width of Uncinate at Midpoint	Rib 4 Width of Uncinate at Midpoint	Rib 5 Width of Uncinate at Midpoint	Rib 6 Width of Uncinate at Midpoint
Francolinus	pondicerianus	1.02	0.78	0.77	0.78
Ardea	alba	3.93	3.19	3.08	0
Tetraogallus	himalayensis	2.37	2.15	2.36	0
Thinocorus	rumicovorus	0.83	0.79	0.79	0.55
Aramus	guarauna	1.81	1.54	1.41	1.17
Ixobrychus	minutus	1.07	0.92	0.81	0
Leptoptilos	crumeniferus	5.1	6.35	5.87	0
Pterocles	exustus	2.17	2.26	2.05	0.95
Sagittarius	serpentarius	5.72	9.26	22.16	18.57
Platalea	leucorodia	3.04	3.32	2.08	0
Scolopax	rusticola	1.78	2.2	1.8	2.04
Branta	leucopsis	2.65	2.73	3.08	2.82
Cygnus	atratus	5.2	5.83	5.21	4.29
Somateria	mollissima	3.19	4.27	4.2	2.1
Anas	falcata	2.07	2.95	2.22	1.28
Aythya	marila	4.09	4.28	3.14	2.67
Gallinula	chloropus	1.29	1.01	1.1	0.9
Anas	acuta	2.39	2.8	2.15	1.49
Tadorna	ferruginea	2.6	3.02	2.01	1.45
Tadorna	tadorna	4.05	4.07	3	3.05
Anser	albifrons	4.31	3.46	3.65	3.15
Falco	tinnuculus	1.98	1.33	1.56	1.21
Tetrao	urogallus	2.6	3.08	2.38	1.28
Casuarius	casuarius	0	12.98	10.57	11.78
Apteryx	haastii	8.07	6.85	7.25	2.94
Dinornis	maximus	21.32	24.65	18.66	18.44
Struthio	camelus	14.5	11.96	10.73	0
Phasianus	colchicus	1.83	1.92	1.54	0
Geococcyx	californianus	1.75	1.69	1.49	0
Eudromia	elegans	1.7	1.59	1.67	0
Meleagris	gallopavo	2.33	2.2	1.67	0
Alectoris	rufa	1.42	1.68	1.12	0.97

Name		Rib 2 Width of Uncinate at Tip	Rib 3 Width of Uncinate at Tip	Rib 4 Width of Uncinate at Tip	Rib 5 Width of Uncinate at Tip
Fulica	americana	1.28	1.02	1.34	2.43
Gavia	arctica	4.99	4.18	3.74	4.23
Fulica	atra	1.6	1.22	1.31	1.61
Larus	canus	1.37	1.86	1.62	1.22
Alcedo	atthis	1	1.03	0.75	0.84
Mergus	merganser	1.87	3.25	3.16	2.54
Spheniscus	demersus	7.13	6.69	6.68	5.96
Sterna	hirundo	0.65	1.07	1.03	0.95
Pinguinus	impennis	1.89	1.83	1.59	1.48
Spheniscus	humboldti	8.37	6.75	7.97	8.64
Larus	argentatus	2.1	1.95	1.9	0.98
Alle	alle	1.23	0.93	0.84	1.03
Clangula	hyemalis	1.68	2.09	1.83	1.15
Gavia	stellata	1.52	1.66	1.58	2
Pelecanus	rufescens	3.48	3.46	2.58	4.76
Aptenodytes	patagonicus	14.61	16.13	17.6	15.85
Fumarus	glacialis	2.16	1.61	1.64	1.74
Alca	torda	1	0.96	1.52	1.91
Aythya	fuligula	2.03	2.54	2.69	2.31
Cinclus	cinclus	0.76	0.81	0.99	0.88
Sterna	paradisaea	0.79	0.78	0.97	0.92
Phalacrocorax	carbo	3.03	3.94	2.19	1.46
Phalacrocorax	bougainvillii	3.66	3.84	3.08	4.88
Podiceps	cristatus	2.3	2.25	1.71	1.84
Tockus	nasutus	1.22	1.06	1.45	1.01
Hirundo	rustica	0.48	0.56	0.44	0.45
Gypaetus	barbatus	5.31	6.69	7.25	6.91
Turdus	merula	0.83	0.81	1.02	0.95
Eremopterix	leucotis	0.54	0.38	0.28	0.23
Elanus	caerulus	1.38	1.62	1.75	1.59
Amazona	aestiva	1.77	2.08	2.2	2.25
Columba	bollii	1.19	1.88	1.94	2.07
Melopsittacus	undulatus	0.86	0.96	0.86	0.65
Streptopelia	decaocto	1.23	2.03	2.24	2.24

Name		Rib 2 Width of Uncinate at Tip	Rib 3 Width of Uncinate at Tip	Rib 4 Width of Uncinate at Tip	Rib 5 Width of Uncinate at Tip
Columba	cayennensis	1.53	1.73	1.96	1.96
Corvus	corax	3.1	3.15	3.51	2.37
Passer	domesticus	0.61	0.67	0.63	0.38
Apus	apus	0.53	0.53	0.7	0.52
Vultur	gryphus	0	2.71	3.22	3.24
Chrysococcyx	caprius	0.42	0.55	0.55	0.55
Bubo	bubo	2.45	2.06	2.74	2.05
Sturnus	vulgaris	0.87	0.76	0.64	0.56
Agapornis	fischeri	1.03	0.78	0.72	0.6
Aquila	chrysaetus	4.65	4.33	3.74	4.78
Picoides	viridis	1.66	1.59	1.36	1.24
Buceros	bicornis	4.24	2.64	3.12	3.3
Psittacus	erithacus	1.41	2.33	2.23	2.4
Falco	rusticolus	1.75	1.43	1.9	1.97
Loriculus	galgulus	0.93	0.84	0.79	0.98
Chlamydotis	undulata	5.4	2.64	3.59	2.67
Phaethornis	yaruqui	0.31	0.5	0.38	0.37
Falco	biarmicus	2.15	2.31	1.71	2.36
Chordeiles	acutipennis	0	0.78	1.19	1.23
Athene	noctua	0.84	1.34	1.17	1.09
Bubo	ascalaphus	1.73	2.08	1.72	1.71
Agapornis	roseicollis	0.98	1.03	1	0.51
Mimus	polyglottos	0.32	0.29	0.32	0.25
Oena	capensis	0.97	1.03	1.24	1.25
Trichoglossus	haematodus	2.15	1.63	1.77	1.6
Chrysolampis	mosquitus	0.5	0.4	0.29	0.31
Polytelis	swainsonii	1	1.37	1.45	1.35
Ramphastos	tucanus	1.55	1.75	2.14	1.56
Colius	colius	1.34	1.78	1.77	1.86
Trogon	viridis	0.98	0.8	0.81	0.92
Rostratula	semicollaris	1.53	1.73	1.96	1.96
Perdix	perdix	1.21	1.8	1.92	2.2
Phoenicopterus	rubur	4.93	4.25	4.24	3.49
Botaurus	stellaris	1.92	2.17	2.02	1.46

Name		Rib 2 Width of Uncinate at Tip	Rib 3 Width of Uncinate at Tip	Rib 4 Width of Uncinate at Tip	Rib 5 Width of Uncinate at Tip
Francolinus	pondicerianus	0.98	1.09	1.3	0.94
Ardea	alba	2.93	2.76	2.64	2.74
Tetraogallus	himalayensis	1.85	2.56	3.27	2.86
Thinocorus	rumicovorus	0.62	0.39	0.77	0.82
Aramus	guarauna	0	0.91	1.55	1.35
Ixobrychus	minutus	0.71	0.73	0.68	0.71
Leptoptilos	crumeniferus	0	5.11	6.85	5.9
Pterocles	exustus	0.96	1.19	1.56	1.44
Sagittarius	serpentarius	0	2.67	3.21	16.25
Platalea	leucorodia	3.01	1.73	2.01	1.96
Scolopax	rusticola	0	1.68	2.1	1.78
Branta	leucopsis	2.25	2.25	1.91	1.78
Cygnus	atratus	0	5.58	5.66	4.34
Somateria	mollissima	2.57	3.2	3.35	2.81
Anas	falcata	1.55	2.28	2.31	2.2
Aythya	marila	3.18	3.83	3.18	2.63
Gallinula	chloropus	0.79	1.32	1.01	1.04
Anas	acuta	3.12	2.9	3.3	3.13
Tadorna	ferruginea	2.73	2.14	2.53	1.59
Tadorna	tadorna	1.83	2.28	2.44	2.28
Anser	albifrons	3.48	3.22	3.66	3.11
Falco	tinnuculus	0.76	1.05	1.54	1.59
Tetrao	urogallus	2.04	2.04	1.94	2.5
Casuarius	casuarius	0	0	10.17	8.59
Apteryx	haastii	4.29	5.07	4.46	5.13
Dinornis	maximus	11.54	13.74	13.24	14.3
Struthio	camelus	0	7	7.3	7.84
Phasianus	colchicus	1.94	2.66	1.98	1.55
Geococcyx	californianus	1.55	1.91	1.2	0.72
Eudromia	elegans	1.39	1.8	1.64	1.56
Meleagris	gallopavo	2.02	2	2.07	1.32
Alectoris	rufa	1.81	2.21	1.91	1.87

Name		Rib 6 Width of Uncinate at Tip	Rib 2 Length of UCP	Rib 3 Length of UCP	Rib 4 Length of UCP	Rib 5 Length of UCP	Rib 6 Length of UCP
Fulica	americana	1.76	6.28	14.97	16.26	16.86	18.06
Gavia	arctica	3.04	21.03	31.03	33.89	32.78	25.69
Fulica	atra	1.7	9.62	15.22	18.19	18.61	17.43
Larus	canus	0	13.19	13.59	12	9.41	0
Alcedo	atthis	0	4.47	5.04	3.96	2.17	0
Mergus	merganser	3.14	17.12	18.73	17.44	19.34	15.62
Spheniscus	demersus	8.04	10.52	28.77	28.58	26.59	29.01
Sterna	hirundo	0.8	7.12	9.13	10.08	8.96	7.32
Pinguinus	impennis	1.34	17.63	20.77	22.63	22.4	23.45
Spheniscus	humboldti	3.37	23.42	21.19	24.55	21.35	10.7
Larus	argentatus	0	20.57	21.16	17.38	11.45	0
Alle	alle	0.68	10.56	11.14	12.23	10.39	8.02
Clangula	hyemalis	0.73	18.16	19.32	20.19	19.24	10.13
Gavia	stellata	1.3	21.69	22.86	21.74	16.99	10.88
Pelecanus	rufescens	0	32.04	30.43	22.27	6.69	0
Aptenodytes	patagonicus	8.85	33.57	38.16	46.72	41.7	30.8
Fumarus	glacialis	1.84	5	15.3	17.53	15.91	12.22
Alca	torda	1.67	13.66	16.03	16.66	15.5	14.1
Aythya	fuligula	2.47	14.26	13.47	14.19	12.36	9.04
Cinclus	cinclus	0.62	5.67	6.9	7.23	6.4	2.4
Sterna	paradisaea	0.71	6.73	9.61	9.6	8.75	6.51
Phalacrocorax	carbo	1.41	12.63	20.63	22.12	21.59	19.11
Phalacrocorax	bougainvillii	2.49	19.88	21.11	19.81	22.33	13.62
Podiceps	cristatus	2.14	14.42	16.71	17.83	14.77	13.99
Tockus	nasutus	0.99	7.55	11.24	9.97	6.21	5.57
Hirundo	rustica	0	3.57	3.57	3.81	3.13	0
Gypaetus	barbatus	4.16	15.51	32.19	41.17	40.89	28.99
Turdus	merula	0.67	7.97	9.04	8.53	8.71	4.13
Eremopterix	leucotis	0.24	3.36	4.32	4.33	4.1	2.8
Elanus	caerulus	1.35	8.1	11.54	14.26	13.1	9.57
Amazona	aestiva	1.96	8.08	11.38	11.26	13.67	14.05
Columba	bollii	2.32	4.77	6.91	8.92	9.87	6.68
Melopsittacus	undulatus	0.65	1.96	3.71	4.09	4.3	2.96
Streptopelia	decaocto	1.65	4.27	5.55	7.57	7.87	6.17

Name		Rib 6 Width of Uncinate at Tip	Rib 2 Length of UCP	Rib 3 Length of UCP	Rib 4 Length of UCP	Rib 5 Length of UCP	Rib 6 Length of UCP
Columba	cayennensis	1.92	7.75	9.12	9.45	9.45	4.86
Corvus	corax	0	16.99	17.45	16.87	14.21	0
Passer	domesticus	0.37	4.31	5.14	5.43	4.84	3.46
Apus	apus	0.48	2.56	4.37	4.37	4.84	3.97
Vultur	gryphus	3.18	0	24.06	39	33.21	23.24
Chrysococcyx	caprius	0	2.14	4.03	4.11	3.77	0
Bubo	bubo	1.29	10.9	14.58	17.44	17.19	17.16
Sturnus	vulgaris	0.48	7.02	7.88	7.35	4.74	1.79
Agapornis	fischeri	0.7	1.97	3.95	4.76	3.43	1.68
Aquila	chrysaetus	5.06	13.49	21.28	29.19	31.32	27.01
Picoides	viridis	0	7.59	8.36	7.14	4.8	0
Buceros	bicornis	0	9.29	15.52	13.95	13.64	0
Psittacus	erithacus	1.84	1.82	5.95	8.88	10.34	5.14
Falco	rusticolus	2.21	11.43	19.17	19.62	21.32	20
Loriculus	galgulus	0.3	1.6	3.45	4.6	3.31	1.71
Chlamydotis	undulata	2.22	10.08	18.8	23.34	24.99	17.1
Phaethornis	yaruqui	0	1.89	1.89	2.06	2.06	0
Falco	biarmicus	2.91	6.3	12.5	13.06	16.65	15.53
Chordeiles	acutipennis	0.77	0	5.42	6.45	7.26	5.08
Athene	noctua	0	6.42	9.13	10.13	8.23	0
Bubo	ascalaphus	0	6.67	8.83	11.79	12.58	0
Agapornis	roseicollis	0.75	4.22	5.18	5.17	4.47	1.85
Mimus	polyglottos	0.24	3.02	3.38	2.55	2.25	1.5
Oena	capensis	1.05	3.7	3.89	4.17	4.16	2.88
Trichoglossus	haematodus	1.23	2.92	6.89	8.9	7.52	5.28
Chrysolampis	mosquitus	0.31	1.74	2.23	2.23	2.35	1.82
Polytelis	swainsonii	0.57	3.93	5.31	6.6	6.6	6.8
Ramphastos	tucanus	2.3	10.73	12.32	11.17	9.54	2.45
Colius	colius	1.44	4.46	6.2	6.35	6.34	4.87
Trogon	viridis	0	4.47	6.56	6.54	4.87	0
Rostratula	semicollaris	1.92	7.75	9.12	9.45	9.45	4.86
Perdix	perdix	1.77	6.5	6.73	5.74	5.22	2.52
Phoenicopterus	rubur	3.01	27.18	29.07	29.05	21.37	12.1
Botaurus	stellaris	1.22	6	4.16	4.16	4.34	3.6

Name		Rib 6 Width of Uncinate at Tip	Rib 2 Length of UCP	Rib 3 Length of UCP	Rib 4 Length of UCP	Rib 5 Length of UCP	Rib 6 Length of UCP
Francolinus	pondicerianus	0.71	4.4	4.4	4.82	4.62	2.96
Ardea	alba	0	9.55	13.51	13.5	9.39	0
Tetraogallus	himalayensis	0	8.26	10.47	11.99	10.67	0
Thinocorus	rumicovorus	0.5	4.34	6.38	5.85	6.98	3.69
Aramus	guarauna	0.99	0	5.9	9.15	10.63	8
Ixobrychus	minutus	0	1.82	4.07	3.8	1.97	0
Leptoptilos	crumeniferus	0	0	17.26	20.76	18.8	0
Pterocles	exustus	0.91	3.22	5.13	7.16	8.77	4.57
Sagittarius	serpentarius	13.06	0	14.32	14.84	12.98	11.17
Platalea	leucorodia	0	6.54	12.49	10.58	8.2	0
Scolopax	rusticola	2.03	0	4.92	5.99	6.02	7.46
Branta	leucopsis	1.86	5.75	10.83	11.32	11.06	12.16
Cygnus	atratus	4.41	0	15.95	19.58	21.59	19.54
Somateria	mollissima	2.97	9.95	15.57	14.12	15.15	17
Anas	falcata	0.82	11.32	12.01	9.78	9.49	6.26
Aythya	marila	2.16	13.9	11.67	10.58	12.86	13.05
Gallinula	chloropus	1.18	8.98	10.97	11.43	11.98	11.42
Anas	acuta	1.53	12.47	12.46	12.71	7.99	8.74
Tadorna	ferruginea	1.42	8.45	10.53	9.28	9.78	8.58
Tadorna	tadorna	2.22	7.23	7.78	7.18	10.08	12.87
Anser	albifrons	3.07	12.79	13.68	14.01	13.98	12.01
Falco	tinnuculus	1.11	5.71	8.68	10.85	11.54	8.47
Tetrao	urogallus	1.3	8.22	10.81	12.11	13.51	10.35
Casuarius	casuarius	10.52	0	0	15.34	27.32	29.53
Apteryx	haastii	2.55	27.45	25.29	29.48	21.89	11.71
Dinornis	maximus	9.57	40.91	45.34	43.8	51.83	47.81
Struthio	camelus	0	0	24.83	35.41	31.18	0
Phasianus	colchicus	0	4.19	6.59	7.46	7.85	0
Geococcyx	californianus	0	3.59	6.63	6.49	3.97	0
Eudromia	elegans	0	3.55	5.87	7.3	6.94	0
Meleagris	gallopavo	0	7.31	7.97	8.18	5.09	0
Alectoris	rufa	0.83	6.03	7.42	7.27	7.3	5.28

Name		Rib 2 Dorsal length to Sternal rib	Rib 3 Dorsal length to Sternal rib	Rib 4 Dorsal length to Sternal rib	Rib 5 Dorsal length to Sternal rib
Fulica	americana	10.49	13.23	14.62	17.81
Gavia	arctica	18.39	15.33	17.35	22.24
Fulica	atra	16.14	16.86	18.05	18.66
Larus	canus	13.91	15.82	19.43	20.69
Alcedo	atthis	5.65	6.47	7.7	8.55
Mergus	merganser	26.72	24.32	24.87	28.93
Spheniscus	demersus	25.12	26.91	28.54	34.32
Sterna	hirundo	6.97	7.81	9.83	11.42
Pinguinus	impennis	25.03	19.52	24.22	32.98
Spheniscus	humboldti	23.95	30.78	35.36	43.07
Larus	argentatus	23.67	30.2	32.81	35.26
Alle	alle	13.72	13.08	19.1	22.86
Clangula	hyemalis	18.81	22.45	29.56	34.98
Gavia	stellata	12.71	13.24	15.95	22.01
Pelecanus	rufescens	35.71	42.81	46.83	51.46
Aptenodytes	patagonicus	56.08	55.25	58.2	69.55
Fumarus	glacialis	13.69	16.52	20.42	23.4
Alca	torda	14.35	13.63	16.15	21.32
Aythya	fuligula	17.34	17.43	19.47	21.34
Cinclus	cinclus	5.9	5.97	7.9	8.66
Sterna	paradisaea	6.05	7.57	9.03	12.05
Phalacrocorax	carbo	18.58	17.26	26.03	26.87
Phalacrocorax	bougainvillii	26.2	28.06	32.38	25.6
Podiceps	cristatus	14.61	15.64	16.57	10.76
Tockus	nasutus	9.04	9.54	12.1	12.17
Hirundo	rustica	4.37	4.69	4.92	5.68
Gypaetus	barbatus	35.6	32.41	31.67	38.45
Turdus	merula	6.52	6.35	8.79	9.52
Eremopterix	leucotis	2.74	3.36	4.28	5.19
Elanus	caerulus	8.51	12.27	17.52	19.68
Amazona	aestiva	7.82	10.91	14.19	15.38
Columba	bollii	8.96	7.52	8.53	10.39
Melopsittacus	undulatus	3.9	3.41	3.73	5.79
Streptopelia	decaocto	8.54	7.99	7.77	7.54

Name		Rib 2 Dorsal length to Sternal rib	Rib 3 Dorsal length to Sternal rib	Rib 4 Dorsal length to Sternal rib	Rib 5 Dorsal length to Sternal rib
Columba	cayennensis	10.17	9.23	9.32	10.5
Corvus	corax	19.82	25.29	27.61	33.05
Passer	domesticus	4.63	5.39	5.6	5.97
Apus	apus	4.33	5.46	6.2	7.63
Vultur	gryphus	0	30.88	39.54	55.81
Chrysococcyx	caprius	2.57	4.58	4.94	5.23
Bubo	bubo	19.07	17.31	19.59	23.38
Sturnus	vulgaris	5.93	6.98	7.1	8.65
Agapornis	fischeri	5.35	5.25	5.71	6.86
Aquila	chrysaetus	13.99	14.79	22.31	22.65
Picoides	viridis	7.35	10.19	12.86	15.79
Buceros	bicornis	24.78	27.06	34.37	40.83
Psittacus	erithacus	10.16	13.74	12.79	15.77
Falco	rusticolus	12.56	12.43	16.29	19.78
Loriculus	galgulus	3.09	3.41	4.9	6.11
Chlamydotis	undulata	15.27	22.42	21.42	28.73
Phaethornis	yaruqui	2.07	1.68	3.87	5.1
Falco	biarmicus	9.75	11.84	12.99	15.55
Chordeiles	acutipennis	0	4.68	3.65	4.02
Athene	noctua	3.96	6.9	7.35	9.38
Bubo	ascalaphus	13.11	13.74	15.85	20.25
Agapornis	roseicollis	4.44	4.55	5.3	6.69
Mimus	polyglottos	2.87	2.73	4.54	5.85
Oena	capensis	3.46	4.34	4.21	5.03
Trichoglossus	haematodus	7.05	8.37	8.46	10.04
Chrysolampis	mosquitus	1.69	1.53	1.82	2.29
Polytelis	swainsonii	0	5.43	6.97	7.9
Ramphastos	tucanus	11.81	12.91	16.54	16.88
Colius	colius	3.79	4.66	4.56	5.74
Trogon	viridis	7.7	6.99	7.59	9.84
Rostratula	semicollaris	10.17	9.23	9.32	10.5
Perdix	perdix	6.43	10.1	10.15	11.49
Phoenicopterus	rubur	22.05	28.29	21.56	33.91
Botaurus	stellaris	16.67	21.02	25.91	30.4

Name		Rib 2 Dorsal length to Sternal rib	Rib 3 Dorsal length to Sternal rib	Rib 4 Dorsal length to Sternal rib	Rib 5 Dorsal length to Sternal rib
Francolinus	pondicerianus	5.52	7.24	7.58	7.63
Ardea	alba	28.31	33.99	43.02	48.61
Tetraogallus	himalayensis	19.06	19.3	20.51	20.95
Thinocorus	rumicovorus	5.4	4.35	5.93	6.55
Aramus	guarauna	0	13.86	14.56	18.47
Ixobrychus	minutus	9.76	12.54	11.47	18.53
Leptoptilos	crumeniferus	0	63.87	57.32	74.8
Pterocles	exustus	7.14	6.42	6.65	7.54
Sagittarius	serpentarius	0	22.53	25.55	33.06
Platalea	leucorodia	23.39	18.9	22.98	31.12
Scolopax	rusticola	0	6.61	6.64	14.34
Branta	leucopsis	16.09	21.89	57.69	26.96
Cygnus	atratus	0	39.43	49.96	58.25
Somateria	mollissima	26.83	25.01	25.5	29.55
Anas	falcata	12.5	18.06	15.24	20.55
Aythya	marila	21.85	20.25	24.05	27.84
Gallinula	chloropus	9.01	12.82	13.04	14.8
Anas	acuta	24.27	19.88	18.82	24.47
Tadorna	ferruginea	16.53	17.2	17.3	20.31
Tadorna	tadorna	13.89	19.59	17.87	21.11
Anser	albifrons	29.95	29.29	29	37.78
Falco	tinnuculus	6.46	5.81	4.71	7.01
Tetrao	urogallus	15.51	18.36	20.54	23.25
Casuarius	casuarius	0	0	44.18	38.28
Apteryx	haastii	21.66	20.27	26.99	30.3
Dinornis	maximus	35.77	92.83	106.47	134.35
Struthio	camelus	0	58.79	91.05	96.39
Phasianus	colchicus	5.16	7.94	7.69	8.2
Geococcyx	californianus	10.59	13.3	11.91	12.16
Eudromia	elegans	3.99	4.01	6.39	5.07
Meleagris	gallopavo	9.75	10.19	8.86	8.82
Alectoris	rufa	0	10.09	12.83	12.84

Name		Rib 6 Dorsal length to Sternal rib	Rib 2 Total Length of Dorsal Rib	Rib 3 Total Length of Dorsal Rib	Rib 4 Total Length of Dorsal Rib
Fulica	americana	19.35	32.04	36.97	39.67
Gavia	arctica	28.73	74.05	75.9	80.11
Fulica	atra	22.63	40.43	45.01	49.36
Larus	canus	0	38.68	39	40.96
Alcedo	atthis	0	16.63	18.73	19.29
Mergus	merganser	37.28	62.17	62.17	61.3
Spheniscus	demersus	41.79	76.48	84.22	86.59
Sterna	hirundo	12.57	26.27	28.01	29.28
Pinguinus	impennis	43.76	58.75	60.03	66.83
Spheniscus	humboldti	52.42	75.35	83.5	87.35
Larus	argentatus	0	63.75	67.17	68.21
Alle	alle	27.41	35.01	36.49	41.6
Clangula	hyemalis	45.21	52.1	56.06	60.56
Gavia	stellata	27.83	54.72	55.99	57.88
Pelecanus	rufescens	0	108.65	112.17	111.06
Aptenodytes	patagonicus	85.84	141.05	146.8	151.08
Fumarus	glacialis	23.16	45.43	50.2	53.32
Alca	torda	28.68	45.89	49.1	52.75
Aythya	fuligula	27.35	41.87	42.94	45.76
Cinclus	cinclus	8.98	18.65	20.42	22.84
Sterna	paradisaea	14.52	23.55	24.99	25.97
Phalacrocorax	carbo	31.11	56.18	58.09	66.26
Phalacrocorax	bougainvillii	34.56	68.18	70.66	71.43
Podiceps	cristatus	16.35	45.26	47.97	50.35
Tockus	nasutus	15	27.78	29.2	31.31
Hirundo	rustica	0	11.85	12.53	13.14
Gypaetus	barbatus	53.75	90.31	92.47	93.6
Turdus	merula	13.15	20.05	20.95	23.39
Eremopterix	leucotis	6.05	9.48	10.56	11.54
Elanus	caerulus	23.81	27.59	25.79	29.14
Amazona	aestiva	16.93	28.58	33.51	35.68
Columba	bollii	10.77	24.46	25.98	28.99
Melopsittacus	undulatus	7.83	12.44	13.2	13.53
Streptopelia	decaocto	9.39	21.1	23.51	25

Name		Rib 6 Dorsal length to Sternal rib	Rib 2 Total Length of Dorsal Rib	Rib 3 Total Length of Dorsal Rib	Rib 4 Total Length of Dorsal Rib
Columba	cayennensis	13.66	27.55	28.26	29.77
Corvus	corax	0	55.26	59.34	60.67
Passer	domesticus	7.15	12.36	14.37	14.37
Apus	apus	9.61	12.52	14.83	16.14
Vultur	gryphus	71.67	82.68	91.17	102.71
Chrysococcyx	caprius	0	10.4	13.6	13.61
Bubo	bubo	28.02	37.95	41.86	43.38
Sturnus	vulgaris	10.44	18.05	19.94	20.26
Agapornis	fischeri	8.07	14.67	15.22	15.68
Aquila	chrysaetus	28.82	55.01	59.29	59.25
Picoides	viridis	0	21.16	25.96	28.55
Buceros	bicornis	0	69	75.13	80.39
Psittacus	erithacus	22.05	33.6	39.51	42.11
Falco	rusticolus	25.49	44.57	49.95	55.66
Loriculus	galgulus	6.37	10.9	13.14	14.9
Chlamydotis	undulata	33.15	53.8	60.58	58.54
Phaethornis	yaruqui	0	8.36	8.82	10.48
Falco	biarmicus	16.98	36.58	38.59	40.42
Chordeiles	acutipennis	8.92	7.07	14.57	15.24
Athene	noctua	0	21.9	24.85	25.4
Bubo	ascalaphus	0	46.28	51.28	54.55
Agapornis	roseicollis	7.86	15.03	15.93	16.68
Mimus	polyglottos	7.42	8.46	8.61	10.27
Oena	capensis	6.51	11.98	14.73	14.6
Trichoglossus	haematodus	14.76	20.7	22.63	23.81
Chrysolampis	mosquitus	2.57	7.01	7.51	8.31
Polytelis	swainsonii	8.79	22.17	24.98	26.92
Ramphastos	tucanus	24.61	34.92	34.93	39.33
Colius	colius	9.34	14.04	15.95	16.83
Trogon	viridis	0	21.14	22.42	24.18
Rostratula	semicollaris	13.66	27.55	28.26	29.77
Perdix	perdix	12.55	19.64	22.59	23.83
Phoenicopterus	rubur	39.15	76.07	80.15	76.17
Botaurus	stellaris	0	58.42	64.79	70.02

Name		Rib 6 Dorsal length to Sternal rib	Rib 2 Total Length of Dorsal Rib	Rib 3 Total Length of Dorsal Rib	Rib 4 Total Length of Dorsal Rib
Francolinus	pondicerianus	7.93	15.72	18.1	19.25
Ardea	alba	0	68.95	73.27	79.4
Tetraogallus	himalayensis	0	47	48.66	50.48
Thinocorus	rumicovorus	8.74	16.57	17.56	19.36
Aramus	guarauna	24.9	38.84	41.38	44.77
Ixobrychus	minutus	0	26.61	31.05	31.66
Leptoptilos	crumeniferus	0	111.94	111.4	113.64
Pterocles	exustus	8.09	21.98	22.11	23.13
Sagittarius	serpentarius	38.47	56.87	68.38	72.9
Platalea	leucorodia	0	54.52	53.05	57.34
Scolopax	rusticola	13.81	24.06	25.08	26.3
Branta	leucopsis	31.61	52.9	58.73	61.77
Cygnus	atratus	70.07	95.51	101.48	113.32
Somateria	mollissima	36.83	62.49	62.49	65.1
Anas	falcata	20.18	41.51	42.26	47.88
Aythya	marila	34.54	47.1	49.86	52.87
Gallinula	chloropus	19.15	27.33	32.48	34.45
Anas	acuta	26.76	49.49	46.08	48.72
Tadorna	ferruginea	25.12	41.02	45.06	46.2
Tadorna	tadorna	27.59	41.56	48.93	48.88
Anser	albifrons	41.56	64.94	66.6	64.11
Falco	tinnuculus	7.83	21.58	23.29	22.6
Tetrao	urogallus	17.82	39.85	47.26	52.46
Casuarius	casuarius	45.25	103.24	133.52	146.8
Apteryx	haastii	39.63	57.15	61.18	67.9
Dinornis	maximus	146.62	159.83	223.58	259
Struthio	camelus	0	173.71	239.7	273.8
Phasianus	colchicus	0	22.37	26.4	26.94
Geococcyx	californianus	0	23.17	31.1	33.18
Eudromia	elegans	0	23.83	24.94	27.48
Meleagris	gallopavo	0	30.06	33.12	33.9
Alectoris	rufa	14.11	27.07	28.97	30.51

Name		Rib 5 Total Length of Dorsal Rib	Rib 6 Total Length of Dorsal Rib	Rib 2 Total Length of Sternal Rib
Fulica	americana	43.41	45.72	14.96
Gavia	arctica	88.15	92.34	23.57
Fulica	atra	52.77	55.04	13.42
Larus	canus	43.36	45.41	12.73
Alcedo	atthis	19.26	19.71	8.89
Mergus	merganser	63.61	65.95	0
Spheniscus	demersus	92.83	99	0
Sterna	hirundo	30.04	30.04	7.52
Pinguinus	impennis	78.2	87.08	23.88
Spheniscus	humboldti	92.6	95.86	25.54
Larus	argentatus	69.04	69.1	19.82
Alle	alle	44.54	48.55	18.64
Clangula	hyemalis	63.22	68.87	22.5
Gavia	stellata	61.01	62.33	19.11
Pelecanus	rufescens	112.41	112.04	25.33
Aptenodytes	patagonicus	158.56	166.96	41.57
Fumarus	glacialis	55.66	55.7	13.8
Alca	torda	58.86	65.16	19.46
Aythya	fuligula	47.63	48.9	13.47
Cinclus	cinclus	23.6	21.75	4.76
Sterna	paradisaea	27.22	29.09	7.75
Phalacrocorax	carbo	66.24	67.93	0
Phalacrocorax	bougainvillii	68.89	73.76	29.4
Podiceps	cristatus	46.29	49.15	11.74
Tockus	nasutus	32.09	34.5	10.01
Hirundo	rustica	13.69	14.31	3.26
Gypaetus	barbatus	97.03	105.58	17.27
Turdus	merula	24.5	26.16	7.15
Eremopterix	leucotis	12.27	13.13	3.11
Elanus	caerulus	29.13	32.14	8.73
Amazona	aestiva	37.33	39.87	0
Columba	bollii	30.88	31.24	0
Melopsittacus	undulatus	15.94	17.51	0
Streptopelia	decaocto	24.22	26.07	4.48

Name		Rib 5 Total Length of Dorsal Rib	Rib 6 Total Length of Dorsal Rib	Rib 2 Total Length of Sternal Rib
Columba	cayennensis	29.77	30.57	5.57
Corvus	corax	64.19	67.76	18.66
Passer	domesticus	14.52	15.2	2.8
Apus	apus	17.68	19.42	6.42
Vultur	gryphus	115.35	121.54	27.92
Chrysococcyx	caprius	13.59	13.06	0
Bubo	bubo	43.36	43.63	14.6
Sturnus	vulgaris	21.05	21.86	6.35
Agapornis	fischeri	15.89	16.83	4.12
Aquila	chrysaetus	62	63.45	17.1
Picoides	viridis	30.22	31.59	10.58
Buceros	bicornis	81.87	86.6	22.22
Psittacus	erithacus	43.08	46.01	0
Falco	rusticolus	57.39	59.31	0
Loriculus	galgulus	15.7	14.96	0
Chlamydotis	undulata	66.18	71.85	0
Phaethornis	yaruqui	11.72	11.82	3.74
Falco	biarmicus	40.98	42.47	11.52
Chordeiles	acutipennis	16.14	20.34	0
Athene	noctua	27.16	29.61	9.8
Bubo	ascalaphus	58.99	61.91	16.79
Agapornis	roseicollis	17.82	19.28	4.93
Mimus	polyglottos	11.23	11.63	2.43
Oena	capensis	15.42	16.03	1.58
Trichoglossus	haematodus	25.39	28.12	0
Chrysolampis	mosquitus	8.97	9.56	2.82
Polytelis	swainsonii	27.27	29.14	0
Ramphastos	tucanus	40.88	45.01	12.56
Colius	colius	18.29	19.25	0
Trogon	viridis	26.07	26.42	6.56
Rostratula	semicollaris	29.77	30.57	5.57
Perdix	perdix	24.86	25.4	0
Phoenicopterus	rubur	80.4	81.34	16.61
Botaurus	stellaris	73.13	73.62	24.84

Name		Rib 5 Total Length of Dorsal Rib	Rib 6 Total Length of Dorsal Rib	Rib 2 Total Length of Sternal Rib
Francolinus	pondicerianus	20.28	20.26	0
Ardea	alba	84.41	89.86	11.69
Tetraogallus	himalayensis	51.1	53.55	0
Thinocorus	rumicovorus	21.22	22.65	4.72
Aramus	guarauna	48.78	54.32	10.55
Ixobrychus	minutus	34.05	0	0
Leptoptilos	crumeniferus	126.08	133.52	20.29
Pterocles	exustus	23.63	23.39	7.87
Sagittarius	serpentarius	74.09	75.93	13.6
Platalea	leucorodia	61.42	69.35	13.9
Scolopax	rusticola	29.85	29.84	11.29
Branta	leucopsis	61.77	62.83	8.68
Cygnus	atratus	116.66	120.2	24.45
Somateria	mollissima	70.05	73.06	0
Anas	falcata	46.86	49.53	13.38
Aythya	marila	55.36	59.94	0
Gallinula	chloropus	35.84	39.29	12.72
Anas	acuta	48.8	50.3	11.01
Tadorna	ferruginea	48.09	50.67	10.8
Tadorna	tadorna	48.71	54.42	0
Anser	albifrons	70.2	71.09	16.65
Falco	tinnuculus	24.62	26.35	8.04
Tetrao	urogallus	57.74	54.76	0
Casuarius	casuarius	143.78	141.41	0
Apteryx	haastii	70.87	74.97	20.6
Dinornis	maximus	297.5	318.74	0
Struthio	camelus	266.06	253.64	0
Phasianus	colchicus	28.41	28.41	0
Geococcyx	californianus	34.57	35.21	0
Eudromia	elegans	27.02	28.01	14.98
Meleagris	gallopavo	34.65	32.97	13.62
Alectoris	rufa	31.76	34.5	0

Name		Rib 3 Total Length of Sternal Rib	Rib 4 Total Length of Sternal Rib	Rib 5 Total Length of Sternal Rib
Fulica	americana	14.07	17.76	21.98
Gavia	arctica	30.91	37.15	67.74
Fulica	atra	17.39	23.44	29.86
Larus	canus	16.86	20.59	26.02
Alcedo	atthis	11	12.94	13.47
Mergus	merganser	19.73	24.72	33.86
Spheniscus	demersus	29.22	33.85	58.89
Sterna	hirundo	9.34	11.7	14.6
Pinguinus	impennis	32.93	42.68	58.6
Spheniscus	humboldti	34.69	43.05	55.69
Larus	argentatus	25.57	30.77	37.42
Alle	alle	24.37	30.15	37.23
Clangula	hyemalis	30.3	39.66	50.9
Gavia	stellata	26.77	33.99	45.73
Pelecanus	rufescens	36.87	49.94	67.56
Aptenodytes	patagonicus	56.97	76.31	96.22
Fumarus	glacialis	15.4	20.1	28.06
Alca	torda	24.64	32.9	41.16
Aythya	fuligula	16.49	22.24	27.89
Cinclus	cinclus	6.78	9.6	11.59
Sterna	paradisaea	10.23	13.37	17.64
Phalacrocorax	carbo	0	34.32	45.91
Phalacrocorax	bougainvillii	41.95	53.3	64.03
Podiceps	cristatus	16.47	19.58	35.08
Tockus	nasutus	14.04	18.68	20.56
Hirundo	rustica	4.66	5.89	7.89
Gypaetus	barbatus	24.86	32.33	38.89
Turdus	merula	9.35	11.45	13.03
Eremopterix	leucotis	4.2	4.84	5.71
Elanus	caerulus	10.62	16.13	20.19
Amazona	aestiva	12.15	15.65	20.03
Columba	bollii	8.14	10.65	15.89
Melopsittacus	undulatus	5.55	7.48	9.28
Streptopelia	decaocto	7.98	10.38	13.9

Name		Rib 3 Total Length of Sternal Rib	Rib 4 Total Length of Sternal Rib	Rib 5 Total Length of Sternal Rib
Columba	cayennensis	11.18	14.58	18.9
Corvus	corax	25.12	31.14	36.05
Passer	domesticus	5.21	6.85	8.15
Apus	apus	7.98	9.75	12.18
Vultur	gryphus	27.92	32.58	34.95
Chrysococcyx	caprius	4.7	6.56	8.96
Bubo	bubo	24.55	31.77	38.05
Sturnus	vulgaris	7.63	11.14	13.17
Agapornis	fischeri	6.39	7.56	8.89
Aquila	chrysaetus	23.91	28.76	39.49
Picoides	viridis	13.81	18.21	22.83
Buceros	bicornis	30.52	40.68	53.52
Psittacus	erithacus	10.21	13.84	17.08
Falco	rusticolus	18.88	24.18	27.78
Loriculus	galgulus	5.41	6.4	7.9
Chlamydotis	undulata	21.61	27.18	30.53
Phaethornis	yaruqui	4.27	6.07	6.91
Falco	biarmicus	15.2	20.05	23.77
Chordeiles	acutipennis	0	6.37	7.83
Athene	noctua	12.69	15.67	18.68
Bubo	ascalaphus	19.97	27.65	33.01
Agapornis	roseicollis	6.06	8.05	9.46
Mimus	polyglottos	4.15	4.92	5.4
Oena	capensis	2.79	6.37	9.12
Trichoglossus	haematodus	8.05	11.04	14.01
Chrysolampis	mosquitus	3.2	3.55	4.07
Polytelis	swainsonii	8.19	10.24	11.91
Ramphastos	tucanus	16.4	22.7	26.85
Colius	colius	6.26	7.77	11.25
Trogon	viridis	8.66	10.8	12.47
Rostratula	semicollaris	11.18	14.58	18.9
Perdix	perdix	11.85	16.84	21.14
Phoenicopterus	rubur	25.08	34.5	49.86
Botaurus	stellaris	33.61	42.68	52.9

Name		Rib 3 Total Length of Sternal Rib	Rib 4 Total Length of Sternal Rib	Rib 5 Total Length of Sternal Rib
Francolinus	pondicerianus	9.49	14.31	19.02
Ardea	alba	20.24	24.19	32.28
Tetraogallus	himalayensis	0	0	0
Thinocorus	rumicovorus	5.62	8.17	11.59
Aramus	guarauna	15.54	20.75	25.74
Ixobrychus	minutus	10.98	13.81	14.02
Leptoptilos	crumeniferus	26.53	37.82	45.15
Pterocles	exustus	10.51	13.36	16.75
Sagittarius	serpentarius	22.92	27.76	33.7
Platalea	leucorodia	17.22	21.92	27.42
Scolopax	rusticola	13.82	13.34	15.68
Branta	leucopsis	13.85	19.6	23.15
Cygnus	atratus	30.66	49.26	63.5
Somateria	mollissima	43.8	51.06	55.82
Anas	falcata	16.47	22.52	24.84
Aythya	marila	17.28	22.53	29.33
Gallinula	chloropus	15.22	17.89	20.51
Anas	acuta	14.82	19.78	23.72
Tadorna	ferruginea	13.47	17.33	22.62
Tadorna	tadorna	9.42	13.22	16.51
Anser	albifrons	19.28	25.75	34.13
Falco	tinnuculus	12.09	13.12	15.26
Tetrao	urogallus	14.83	24.59	33.38
Casuarius	casuarius	0	81.04	98.51
Apteryx	haastii	25.75	32.7	38.78
Dinornis	maximus	76.18	113.78	143.4
Struthio	camelus	84.08	119.41	158.23
Phasianus	colchicus	10.98	19.74	24.08
Geococcyx	californianus	15.58	19.25	24.63
Eudromia	elegans	20.84	25.81	29.63
Meleagris	gallopavo	19.64	25.61	32.18
Alectoris	rufa	13.02	15.96	19.15

Name		Rib 6 Total Length of Sternal Rib	Sternum Width at Widest Point	Sternum Length at Longest Point	Sternum Depth
Fulica	americana	26.26	23.37	46.92	21.73
Gavia	arctica	78.9	83.73	187.95	46.77
Fulica	atra	35.4	23.58	57.92	24.43
Larus	canus	32.86	28.81	50.73	27.4
Alcedo	atthis	13.51	12.17	25.94	10.03
Mergus	merganser	41.41	53.11	116.25	21.82
Spheniscus	demersus	70.87	66.4	119.83	44.36
Sterna	hirundo	18.34	16.98	34.43	20.61
Pinguinus	impennis	69.95	39.03	115.09	39.77
Spheniscus	humboldti	68.29	36.83	119.42	40.47
Larus	argentatus	48.27	40.83	67.05	36.66
Alle	alle	43.82	20	56.64	22.9
Clangula	hyemalis	59.66	41.72	98.85	25.21
Gavia	stellata	57.23	56.18	140.82	30.78
Pelecanus	rufescens	85.07	85.05	86.4	58.85
Aptenodytes	patagonicus	119.27	106.95	229.86	62.55
Fumarus	glacialis	37.51	42.39	45.8	32.33
Alca	torda	50.92	34.29	99.04	33.06
Aythya	fuligula	35.13	36.49	63.72	21.31
Cinclus	cinclus	13.29	14.61	25.53	10.36
Sterna	paradisaea	22.37	16.63	32.82	18.75
Phalacrocorax	carbo	54.71	51.82	75.03	27.99
Phalacrocorax	bougainvillii	72.89	56.42	98.41	34.2
Podiceps	cristatus	45.58	38.5	61.69	26.15
Tockus	nasutus	13.35	19.72	36.79	15.21
Hirundo	rustica	9.5	9.75	15.71	6.71
Gypaetus	barbatus	47.58	87.66	111.8	55.7
Turdus	merula	15.62	16.04	29.24	14.15
Eremopterix	leucotis	5.7	7.63	9.84	4.2
Elanus	caerulus	25.98	26.17	38.43	20.65
Amazona	aestiva	23.98	26.17	64.91	28.42
Columba	bollii	18.77	27.35	58.15	31.12
Melopsittacus	undulatus	10.53	10.97	29.41	15.17
Streptopelia	decaocto	18.06	21.17	52.12	27.56

Name		Rib 6 Total Length of Sternal Rib	Sternum Width at Widest Point	Sternum Length at Longest Point	Sternum Depth
Columba	cayennensis	22.67	24.7	58.16	31.57
Corvus	corax	36.11	41.68	69.79	30.04
Passer	domesticus	10.03	11.23	18.21	9.22
Apus	apus	14.82	9.79	26.2	15.65
Vultur	gryphus	45.61	72.18	127.97	69.97
Chrysococcyx	caprius	11.83	8.79	14.84	8.19
Bubo	bubo	46.85	45.14	78.23	38.83
Sturnus	vulgaris	15.29	15.5	29.7	13.08
Agapornis	fischeri	9.99	11.43	31.07	13.63
Aquila	chrysaetus	45.31	57.97	104.09	48.58
Picoides	viridis	22.76	15.89	39.56	17.54
Buceros	bicornis	42.61	53.32	106.07	42.71
Psittacus	erithacus	20.1	27.83	65.98	26.74
Falco	rusticolus	33.07	47.69	81.22	34.21
Loriculus	galgulus	10.89	10.29	24.37	11.67
Chlamydotis	undulata	37.59	51.16	91.68	47.27
Phaethornis	yaruqui	8.02	5.24	14.86	10.55
Falco	biarmicus	26.62	33.88	73.7	38.28
Chordeiles	acutipennis	15.84	14.1	22.89	13.61
Athene	noctua	20.94	18.53	27.25	10.94
Bubo	ascalaphus	36.52	38.74	53.87	33
Agapornis	roseicollis	10.7	14.27	32.15	14.21
Mimus	polyglottos	6.44	6.82	12.79	6.01
Oena	capensis	11.84	12.9	29.27	18.28
Trichoglossus	haematodus	16.09	17.59	45.16	23.83
Chrysolampis	mosquitus	4.99	4.16	15.3	10.63
Polytelis	swainsonii	15.9	18.42	45.61	21.12
Ramphastos	tucanus	30.63	21.3	44.51	15.23
Colius	colius	13.39	12.18	24.82	8.95
Trogon	viridis	7.14	18.89	27.33	14.86
Rostratula	semicollaris	22.67	24.7	58.16	31.57
Perdix	perdix	24.82	48.23	20.09	37.08
Phoenicopterus	rubur	58.3	57.06	109.76	64.6
Botaurus	stellaris	43.75	31.07	69.34	29.56

Name		Rib 6 Total Length of Sternal Rib	Sternum Width at Widest Point	Sternum Length at Longest Point	Sternum Depth
Francolinus	pondicerianus	20.91	16.11	42.49	27.95
Ardea	alba	45.35	50.05	88.29	50.96
Tetraogallus	himalayensis	0	36.87	74.31	59.58
Thinocorus	rumicovorus	14.34	15.65	31.24	20.38
Aramus	guarauna	30.23	26.69	72.24	26.36
Ixobrychus	minutus	0	12.95	29.9	14.09
Leptoptilos	crumeniferus	62.22	79.97	87.89	109.68
Pterocles	exustus	21.76	19.4	57.91	33.66
Sagittarius	serpentarius	41.61	49.23	103.07	50.98
Platalea	leucorodia	35.61	46.43	83.69	38.41
Scolopax	rusticola	18.89	24.08	58.43	30.72
Branta	leucopsis	41.25	52.49	122.14	46.48
Cygnus	atratus	79.08	76.21	191.51	63.84
Somateria	mollissima	57.07	57.84	102.34	34.62
Anas	falcata	33.87	36.67	92.79	27.55
Aythya	marila	37.84	47.16	81.98	26.35
Gallinula	chloropus	23.11	15.64	40.6	16.8
Anas	acuta	29.46	39.1	94.98	25.69
Tadorna	ferruginea	27.52	41.09	88.06	27.64
Tadorna	tadorna	23.2	44.61	88.19	28.07
Anser	albifrons	41.95	56.79	125.99	48.39
Falco	tinnuculus	17.53	23.93	54.23	19.15
Tetrao	urogallus	42.22	104.77	39.67	58.97
Casuarius	casuarius	126.56	208.07	125.37	0
Apteryx	haastii	0	30.13	46.3	0
Dinornis	maximus	152.85	98.22	122.82	0
Struthio	camelus	191.93	207.37	218.45	0
Phasianus	colchicus	25.23	70.32	21	37.73
Geococcyx	californianus	16.86	23.13	32.28	11.45
Eudromia	elegans	0	20.26	83.98	0
Meleagris	gallopavo	20.16	40.33	26.76	48.91
Alectoris	rufa	20.38	43.97	73.08	18.54

Name		Length of Vertebral Column
Fulica	americana	54.49
Gavia	arctica	115.57
Fulica	atra	65.87
Larus	canus	43.06
Alcedo	atthis	17.68
Mergus	merganser	93.18
Spheniscus	demersus	101.93
Sterna	hirundo	33.77
Pinguinus	impennis	81.54
Spheniscus	humboldti	93.21
Larus	argentatus	53.24
Alle	alle	39.49
Clangula	hyemalis	50.62
Gavia	stellata	81.61
Pelecanus	rufescens	106.65
Aptenodytes	patagonicus	185.31
Fumarus	glacialis	68.73
Alca	torda	73.67
Aythya	fuligula	50.98
Cinclus	cinclus	23.77
Sterna	paradisaea	33.13
Phalacrocorax	carbo	90.27
Phalacrocorax	bougainvillii	92.9
Podiceps	cristatus	67.96
Tockus	nasutus	40.83
Hirundo	rustica	13.69
Gypaetus	barbatus	108.85
Turdus	merula	27.25
Eremopterix	leucotis	11.93
Elanus	caerulus	42.95
Amazona	aestiva	51.75
Columba	bollii	38.77
Melopsittacus	undulatus	22
Streptopelia	decaocto	35.15

Name		Length of Vertebral Column
Columba	cayennensis	42.44
Corvus	corax	60.04
Passer	domesticus	18.97
Apus	apus	18.28
Vultur	gryphus	152.83
Chrysococcyx	caprius	20.16
Bubo	bubo	80.45
Sturnus	vulgaris	25.32
Agapornis	fischeri	20.1
Aquila	chrysaetus	105.98
Picoides	viridis	36.23
Buceros	bicornis	122.22
Psittacus	erithacus	55.51
Falco	rusticolus	77.69
Loriculus	galgulus	21.27
Chlamydotis	undulata	73.04
Phaethornis	yaruqui	11.24
Falco	biarmicus	75.12
Chordeiles	acutipennis	18.29
Athene	noctua	29.96
Bubo	ascalaphus	67.93
Agapornis	roseicollis	21.02
Mimus	polyglottos	11.37
Oena	capensis	22.68
Trichoglossus	haematodus	37.57
Chrysolampis	mosquitus	9.94
Polytelis	swainsonii	32.08
Ramphastos	tucanus	51.69
Colius	colius	23.43
Trogon	viridis	22.15
Rostratula	semicollaris	42.44
Perdix	perdix	40.39
Phoenicopterus	rubur	139.03
Botaurus	stellaris	104.15

Name		Length of Vertebral Column
Francolinus	pondicerianus	28.95
Ardea	alba	90.91
Tetraogallus	himalayensis	61.12
Thinocorus	rumicovorus	25.67
Aramus	guarauna	85.26
Ixobrychus	minutus	47.9
Leptoptilos	crumeniferus	163.83
Pterocles	exustus	36.73
Sagittarius	serpentarius	100.54
Platalea	leucorodia	101.67
Scolopax	rusticola	42.61
Branta	leucopsis	88.92
Cygnus	atratus	164.4
Somateria	mollissima	92.82
Anas	falcata	66.71
Aythya	marila	74.96
Gallinula	chloropus	55.41
Anas	acuta	84.32
Tadorna	ferruginea	76.11
Tadorna	tadorna	76.35
Anser	albifrons	97.96
Falco	tinnuculus	39.19
Tetrao	urogallus	65.99
Casuarius	casuarius	333.05
Apteryx	haastii	104.26
Dinornis	maximus	587.7
Struthio	camelus	426.62
Phasianus	colchicus	46.46
Geococcyx	californianus	48.49
Eudromia	elegans	53.07
Meleagris	gallopavo	58.23
Alectoris	rufa	41.71