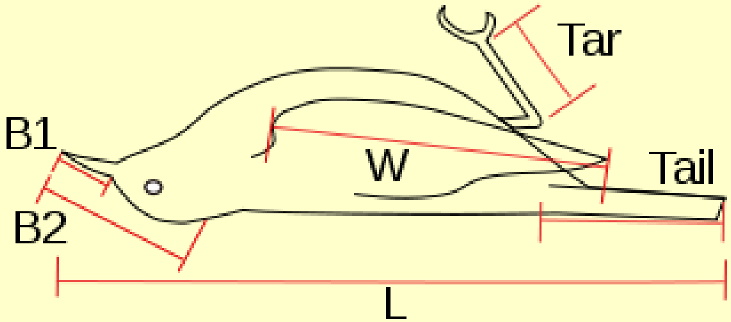
1. Check out your bird

- Where are the feet placed on the body? Measure L



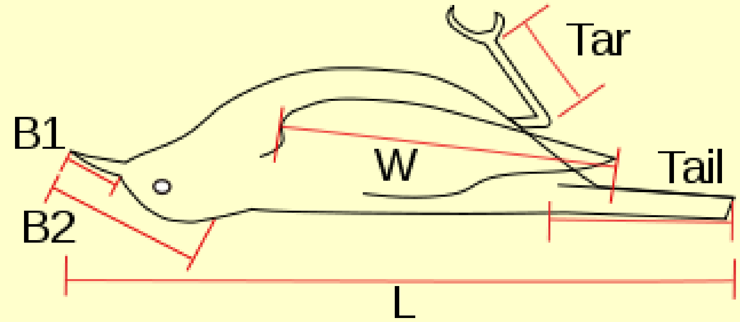
Range of values:

45% Black-winged Petrel (Procellariidae)

to

90% Common Murre (Alcidae)

1. Check out your bird



- Where are the feet placed on the body? Measure L

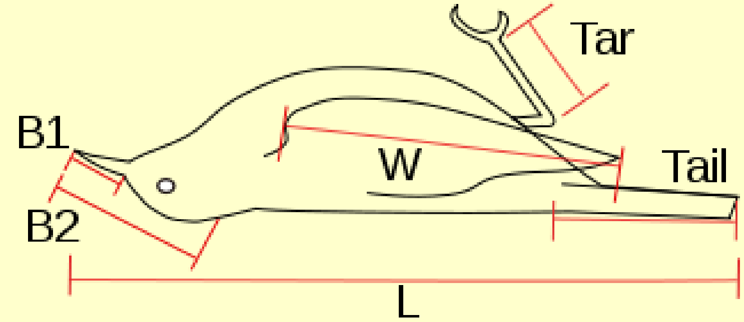
Range of values:

42% Chicken (Phasianidae)

to

100% Western Greebe (Podicipedidae)

1. Check out your bird



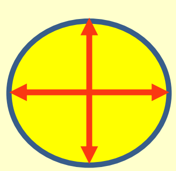
- What are the feet like ?

  Write a brief description and make a drawing

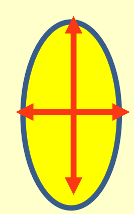
- What is the tarsus like ?
  Write a brief description of the cross-section shape
  (Note: use calipers to measure tarsus cross-section)

Tarsus Ratio = Parallel to leg movement / Perpendicular to leg movement

Round Tarsus



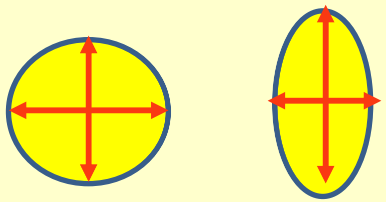
(Wood 1993)



Elliptical Tarsus

1. Check out your bird

Tarsus Ratio = $\dfrac{\text{Parallel to leg movement}}{\text{Perpendicular to leg movement}}$



Range of values:		Values < 1.00	
1.00	Black-winged Petrel (Procellariidae)	0.84	Chicken (Phasianidae)
to		to	
2.01	Common Murre (Alcidae)	0.82	Glaucous-Winged Gull (Laridae)

Tarso-metatarsus Section Ratio (Wood 1993)

Major and minor axes (a and b) of one tarsus per bird measured with vernier calipers at mid-point between ankle and knee.

Cross-section ratio (a / b) reflects the extent to which tarsus is laterally compressed.

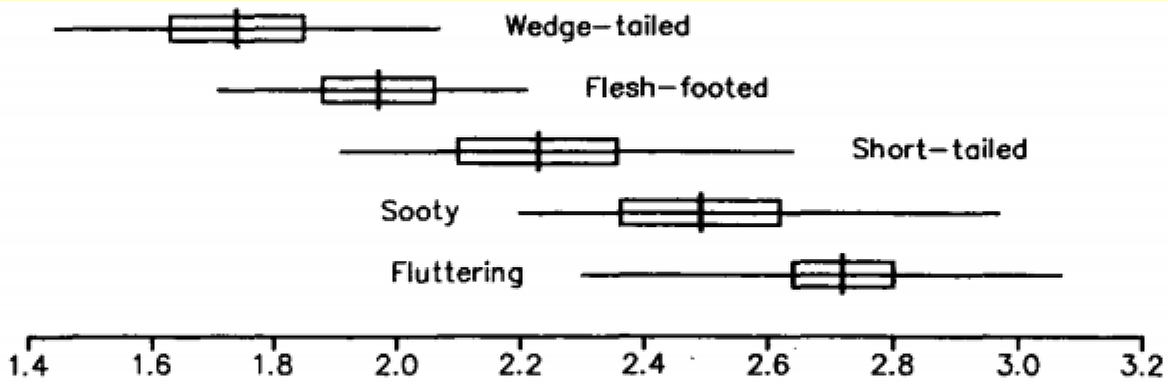


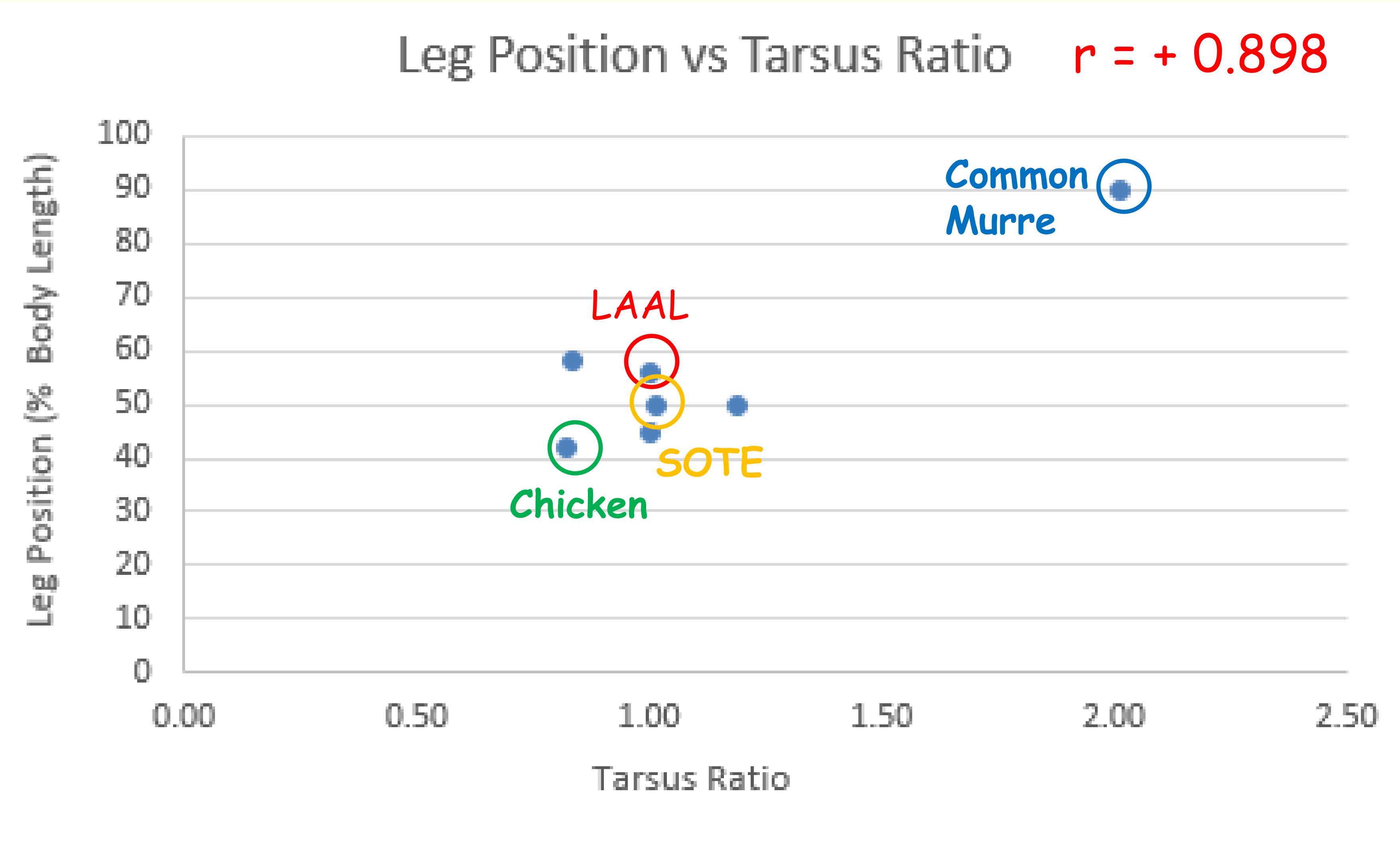
FIGURE 1 — Shearwater tarsometatarsus section ratio (a/b) indicating mean, ± 99% confidence limits of mean (rectangle) and range (horizontal line).

TABLE 1 — Scavenging techniques and offal preferences of shearwaters off Wollongong, N.S.W.

Species	Offal Type		Scavenging Technique				
	Fish	Fat	Surface Seizing	Contact Dipping	Surface Plunging	Shallow Diving	Pursuit Diving
Wedge-tailed *P. pacificus*	XX	O	XX	X	XX	O	O
Flesh-footed *P. carneipes*	XX	O	XX	X	XX	O	O
Short-tailed *P. tenuirostris*	XX	O	X	O	X	X	X
Sooty *P. griseus*	XX	O	X	O	X	X	X

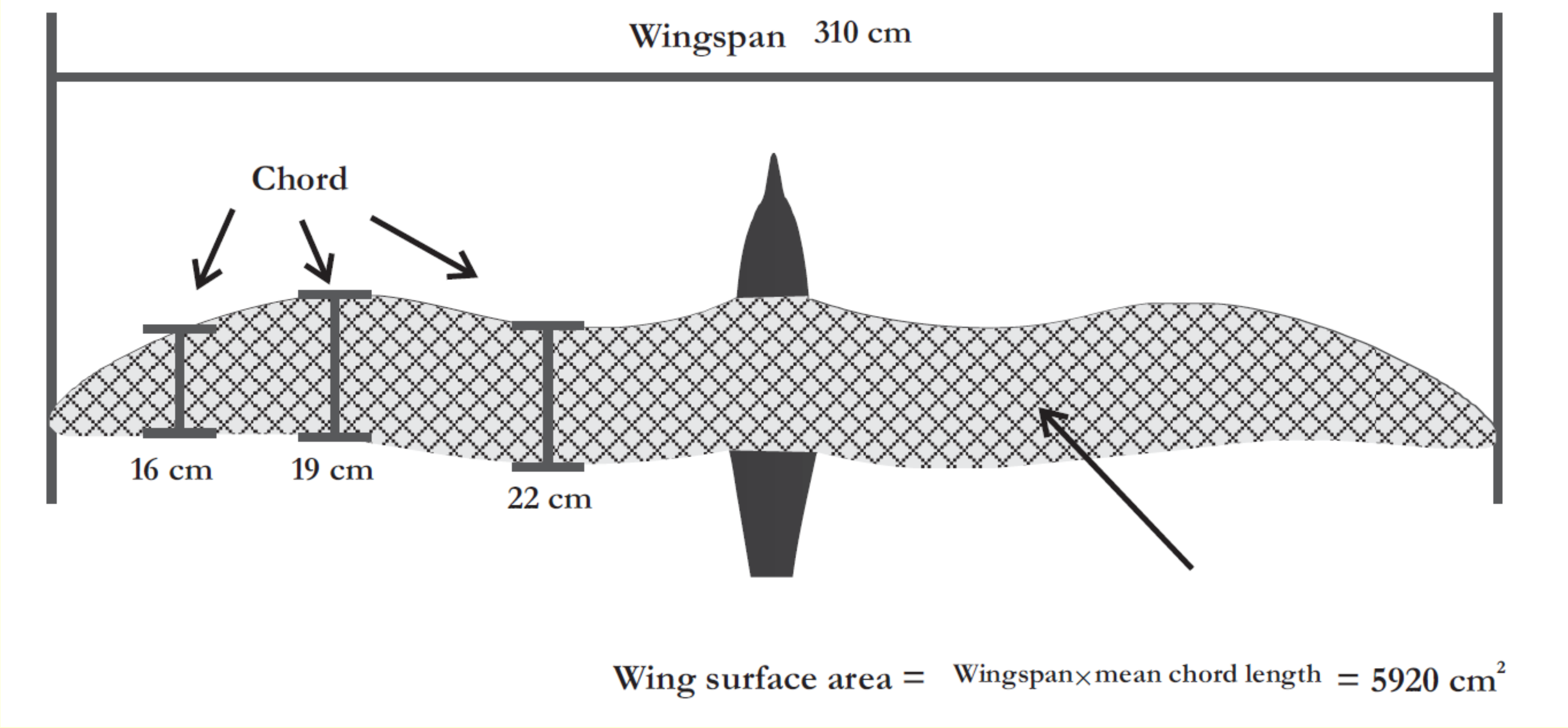
XX indicates highest preference or usage
O indicates no preference or usage

Leg Position vs Tasus Ratio



2. Make Bird Measurements

- Weight (to the closest gram):
- Lay out bird on its back and stretch the wings out.



2. Make Wing Measurements

Wing Span =

Wing Chord =

Wing Aspect Ratio =

Wing Loading =

2. Make Wing Measurements

Mass = 7960 g

Wingspan = 310 cm

$$\text{Mean chord length} = \frac{16\text{ cm} + 19\text{ cm} + 22\text{ cm}}{3} = 19\text{ cm}$$

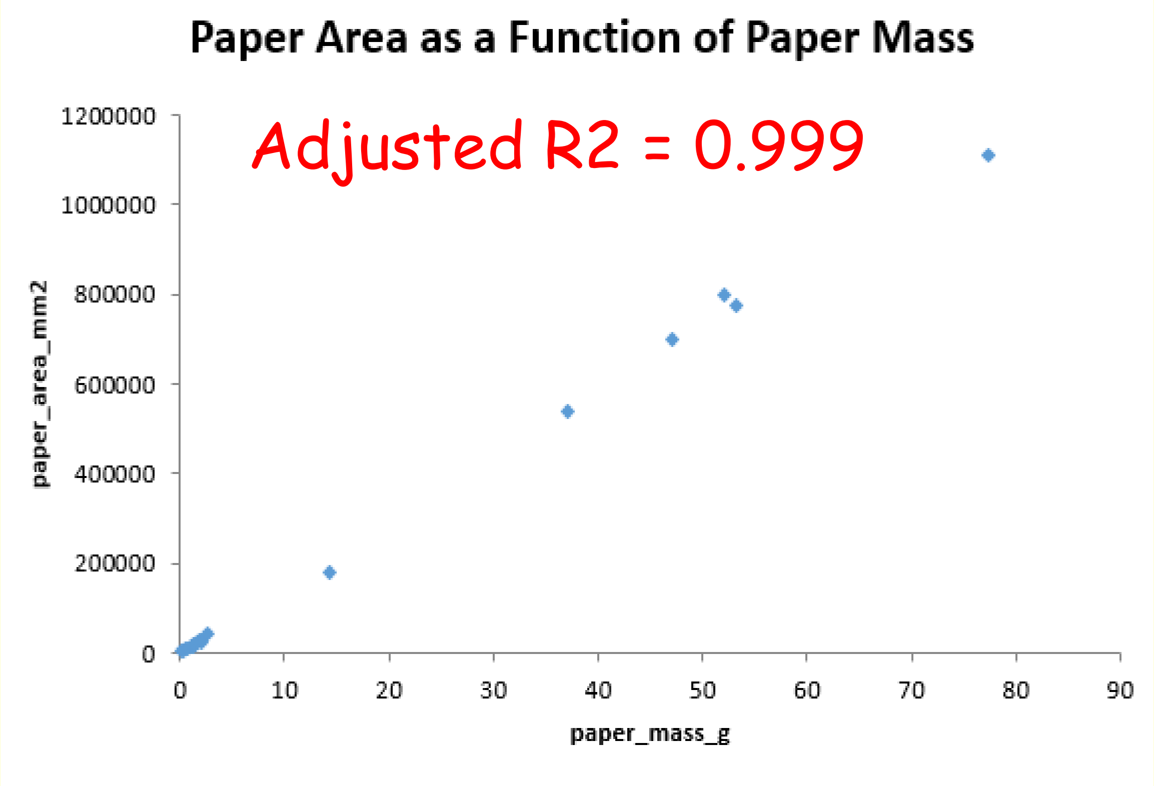
$$\text{Wing surface area} = \text{Wingspan} \times \text{mean chord length} = 5920\text{ cm}^2$$

$$\text{Aspect ratio} = \frac{\text{Wingspan}}{\text{Mean chord length}} = \frac{310\text{ cm}}{19\text{ cm}} = 16.32$$

$$\text{Wing loading} = \frac{\text{Mass} \times \text{acceleration}}{\text{Wing surface area}} = \frac{7960_{g} \times 9.81_{m/s^2}}{5990_{cm^2}} = 13.26_{N/cm^2}$$

3. Estimate Wing Area

bird	paper_mass_g	paper_area_mm2
RTTR	53.3	776160
BWPE	14.3	180090
SOTE	52	798000
COMU	37.1	540796
GWGU	77.4	1109934
CHKN	47	697680
scale1	0.2	2500
scale2	0.4	5000
scale3	0.6	7500
scale4	0.8	10000
scale5	1	12500
scale6	1.2	15000
scale7	1.3	20000
scale8	1.7	25000
scale9	1.9	27500
scale10	2.1	30000
scale11	2	25000
scale12	2.7	40000



ANOVA

	df	SS	MS	F	Significance F
Regression	1	2.24738E+12	2.25E+12	12602.7	1.31276E-24
Residual	16	2853199535	1.78E+08		
Total	17	2.25023E+12			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-1793.581226	3814.659994	-0.47018	0.644571	-9880.299163	6293.136711
paper_mass_g	14663.11267	130.6153838	112.2618	1.31E-24	14386.22042	14940.00491

3. Estimate Wing Area

Regression Equation:

Paper_Area_mm2 = -1793.58122641057 + (14663.1126669205* Paper_Mass_g)

Species	CutOut_Mass_g	CutOut_Area_mm2	Wing_Area_m2
RTTR	6.2	89118	0.089
BWPE	2.8	39263	0.039
SOTE	2.9	40729	0.041
COMU	2.7	37797	0.038
GWGU	15.1	219619	0.220
CHKN	5.6	80320	0.080

Example: Laysan Albatross

Mass = 1307 g = 1.307 kg

Wing Area = 272209 mm2 = 0.272 m2

Wing Span = 1897 mm = 1.897 m

Mean Wing Chord =

Mean Wing Chord = Wing Area / Wing Span
= 0.272 m2 / 1.897 m = 0.143 m

Wing Aspect Ratio =

Wing Aspect Ratio = Wing Span / Wing Chord
= 1.987 / 0.143 = 13.89

4. Estimate Wing Loading

Mass = 1307 g = 1.307 kg

Wing Area = 272209.7 mm2 = 0.272 m2

Wing Loading (g / mm2) = 1307 g / 272209 mm2
Wing Loading (g / mm2) = 0.00480 g / mm2

Wing Loading (kg / m2) = 1.307 g / 0.272 m2
Wing Loading (kg / m2) = 4.805 kg / m2

4. Estimate Wing Loading

N = One newton is the force needed to accelerate one kilogram of mass at the rate of one meter per second squared in direction of the applied force.

Wing Loading (kg / m2) = 1.307 kg / 0.272 m2
Wing Loading (kg / m2) = 4.805 kg / m2

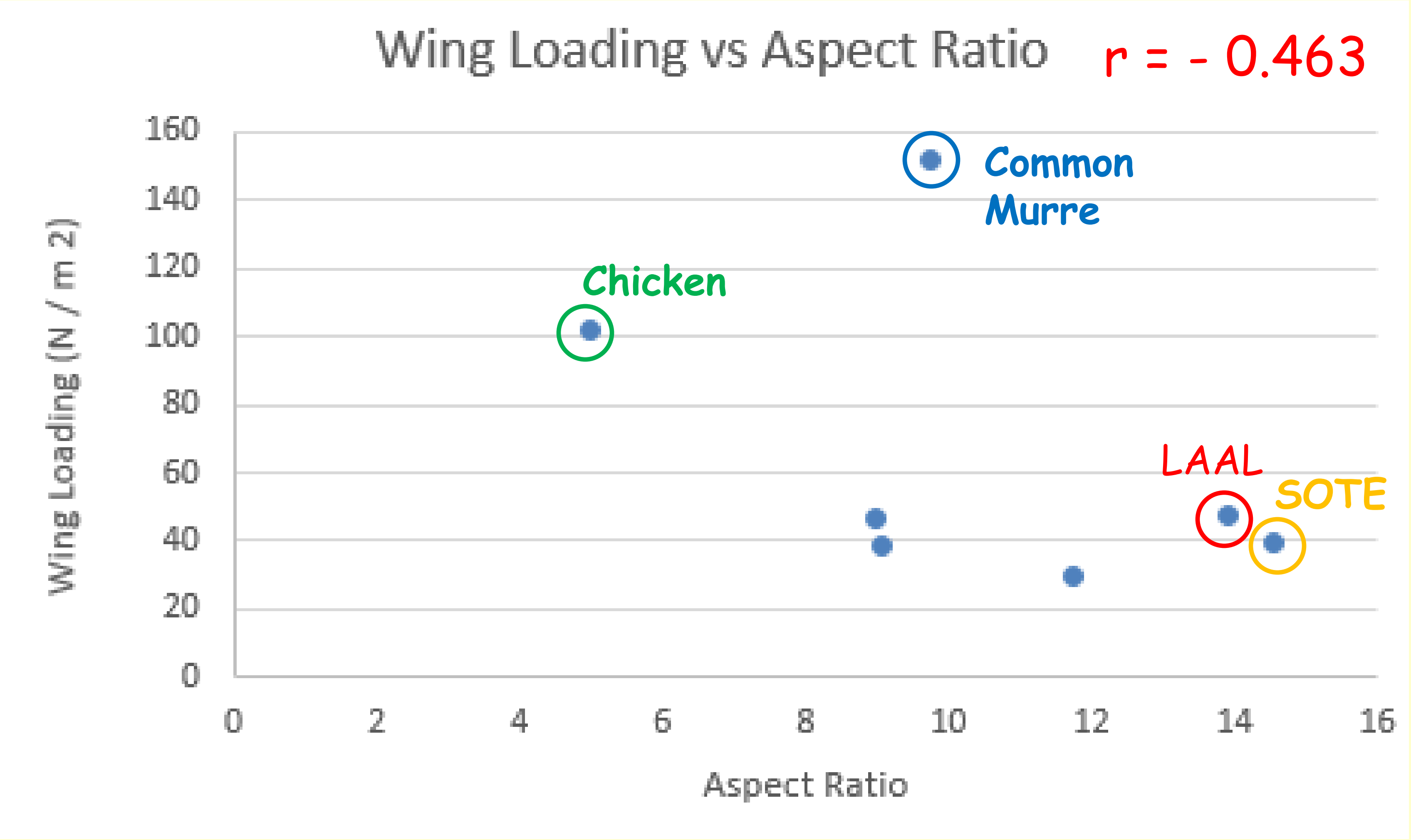
Wing Loading (N / mm2) = (1.307 kg / 272209 mm2) * *G*

Wing Loading (N / mm2) = 0.000047138 N / mm2

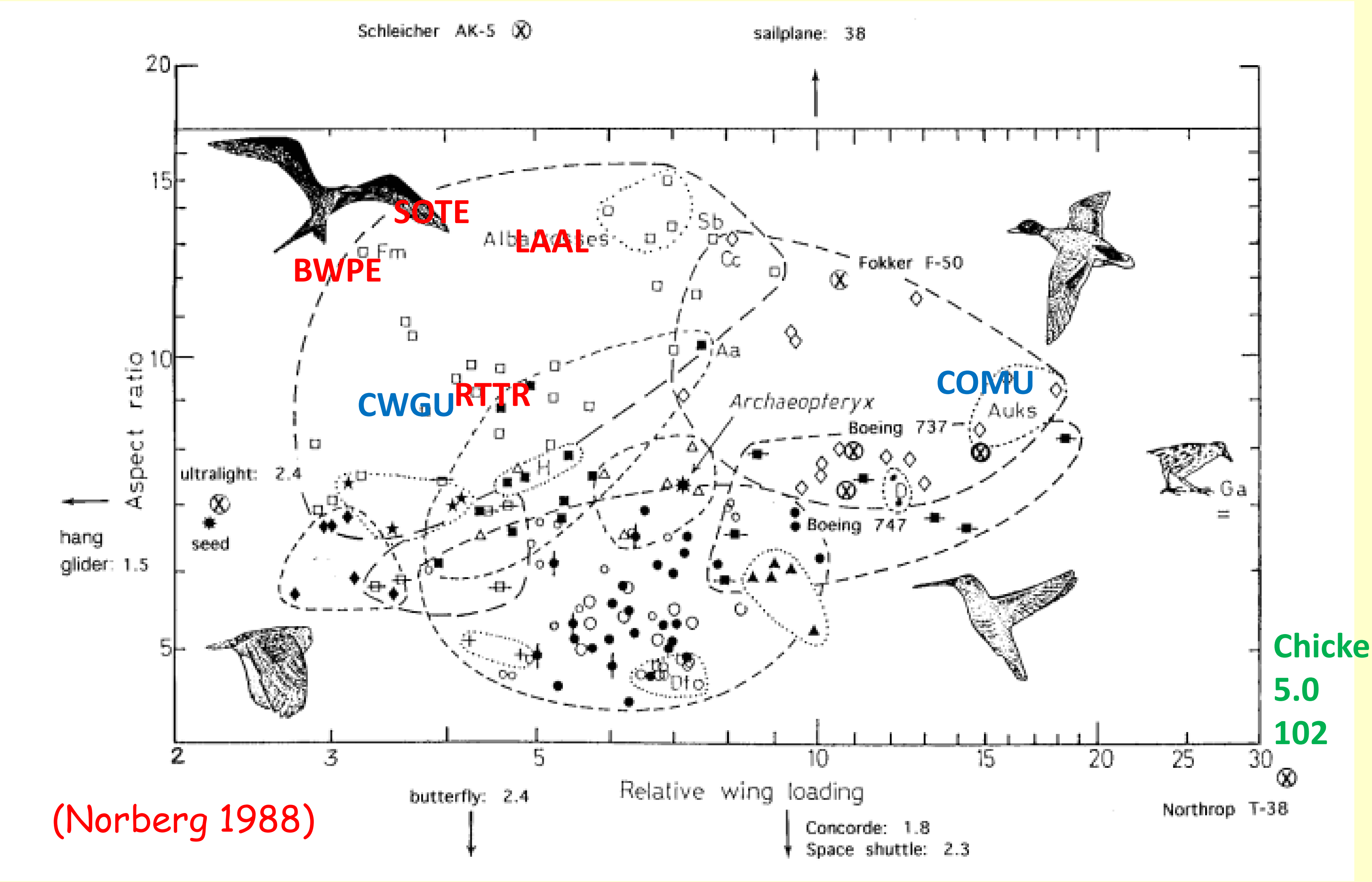
Wing Loading (N / mm2) = (1.307 kg / 0.272 m2) * *G*

Wing Loading (N / mm2) = 47.138 N / m2

Wing Loading vs Aspect Ratio



What does it all Mean ?



(Norberg 1988)