# A note on whole-mass corrections from piecemeal determinations for fur seals

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Received 15 March 1983; accepted 16 March 1983

The whole-mass correction factor from piecemeal determinations of body mass in fur seals (*Arctocephalus* spp.) was found to be lower than that recommended in the literature. A variety of influencing factors are suggested and it is recommended that for each particular study a correction factor should be determined.

Die aanpassingsfaktor vir die bepaling van die totale massa van pelsrobbe (*Arctocephalus* spp.) vanaf stuksgewyse massabepalings is laer as wat in die literatuur aanbeveel word. 'n Verskeidenheid van bepalende faktore word voorgestel en daar word aanbeveel dat vir elke spesifieke studie 'n aanpassingsfaktor bepaal moet word.

In determining the body mass of large animal carcasses, problems are frequently encountered when specimens are either too large for whole weighing, or suitable equipment for this is not available. This difficulty is usually overcome by dissecting the specimen into manageable portions for the available facilities, and the partial masses are then summed to yield an estimate of the total body mass. The resultant piecemeal mass is generally an underestimate of the whole body mass owing to the loss of body fluids during the dissection process. This discrepancy in body mass estimates has either been ignored, or compensated for to a varying degree as shown by Bryden (1972a) in a synthesis on the growth and development of marine mammals. Wilson (1968) presents piecemeal body mass data of a number of large African mammals without accounting for loss of body fluids. Bryden (1972b), on the other hand, specifically collected and weighed blood when dealing with southern elephant seals, *Mirounga leonina*, and assumed no further weight loss, as did Robertson-Bullock (1962) for an African elephant, *Loxodonta africana*. Bryden & Erickson (1976), however, demonstrated a difference between actual whole and piecemeal masses of crabeater seals, *Lobodon carcinophagus*, despite the collection of blood and the inclusion of blood mass in body mass estimates.

To compensate for weight loss owing to the loss of body fluids, the American Society of Mammalogists (1967) recommend a 10% allowance when seals are weighed piecemeal. Bryden (1972a) estimated blood volume to be 10–22% of body weight in marine mammals, and as relative blood volumes in diving mammals are greater than in non-diving mammals (Harrison & Tomlinson 1956; Simpson, Gilmartin & Ridgeway 1970), mass corrections for piecemeal determinations have particular application in marine mammals. The present paper deals with these corrections for fur seals (*Arctocephalus* spp.) occurring at Gough and Marion Islands.

Whole and piecemeal masses were determined for 33 adult fur seals, collected by shooting through the neck with a .22-calibre rifle. The Marion Island sample consisted of 17 subantarctic male fur seals (*A. tropicalis*), four male antarctic fur seals (*A. gazella*) and four male *A. tropicalis* / *A. gazella* hybrids. Five male and three female *A. tropicalis* were collected from Gough Island.

The complete carcasses were weighed using a 200-kg spring scale (Salter) suspended from a tripod. The Gough Island seals were then sectioned into four portions: (i) head (ii) forelimbs with scapulae (iii) viscera and (iv) remainder of the carcass. The portions of the males were reweighed together on a stretcher while the female portions were individually weighed using a 25-kg spring scale (Salter). The Marion Island carcasses were similarly treated but were skinned before further dissection, the skin being weighed together with the head. All portions, except the stripped carcass which was hooked directly onto the scale, were reweighed in a bucket. No attempt was made to collect blood for weighing. The differences between the sampling techniques are not thought to have affected the time for the total procedure as the Gough samples, while not skinned, were intensively investigated for reproductive status.

Piecemeal mass was calculated as the sum of the masses of the individual portions. The correction factor used to adjust for loss of body fluids through sectioning was calculated as the difference between the whole mass and the piecemeal mass, expressed as a percentage of the whole mass.

The results are presented in Table 1. The whole and piecemeal masses differed significantly ($t = 10{,}03$; df = 32; $p < 0{,}001$) and the mean percentage weight loss for the entire sample was $3{,}03 \pm 1{,}91$ ($\bar{x} \pm$ S.D.).

For cetaceans, weight loss through piecemeal mass determination was estimated as 20% in the fin whale, *Balaenoptera physalus* (Quiring 1943), 10–13% in blue whales, *B. musculus* (Nishiwaki 1972), and calculated as 12% for an adult sperm whale, *Physeter catodon* (Gambell 1970).

For pinnipeds a weight loss of 5% was estimated for a single southern elephant seal (Hamilton 1949). The percentage weight loss in crabeater seals, however, ranged between 0,45–20,8%, with a mean of 8,0% (calculated from data presented in Bryden & Erickson 1976), despite the inclusion of the exsanguinated blood in the weight estimate. Innes, Stewart & Lavigne (1981) in their work on the harp seal, *Phoca groenlandica*, used the 10% correction factor recommended by the American Society of Mammalogists (1967). Miller (1975), referring to Bryden (1972a), also opted for the 10% figure to compensate for weight loss in a single adult male New Zealand fur seal, *A. forsteri*, while Paulian (1964) did not take any weight loss into account for piecemeal measurements of *A. tropicalis*.

**Table 1** The relationship between whole mass and piecemeal mass for fur seals on Marion and Gough Islands

| Island | Species | *n* | Sex | Mean whole mass (kg) ± S.D. | Mean piecemeal mass (kg) ± S.D. | % Weight loss ± S.D. |
|---|---|---|---|---|---|---|
| Gough | *A. tropicalis* | 5 | ♂ | 108,0 ± 40,3 | 104,4 ± 39,7 | 3,54 ± 1,3 |
| | *A. tropicalis* | 3 | ♀ | 34,5 ± 3,1 | 32,8 ± 2,8 | 4,86 ± 3,0 |
| Mean for Gough Island | | 8 | | 80,4 ± 48,8 | 77,6 ± 47,7 | 4,04 ± 2,03 |
| Marion | *A. tropicalis* | 17 | ♂ | 88,1 ± 17,5 | 86,1 ± 17,6 | 2,35 ± 1,6 |
| | *A. gazella* | 4 | ♂ | 75,0 ± 13,7 | 71,6 ± 14,2 | 4,76 ± 2,2 |
| | *Arctocephalus* sp. | 4 | ♂ | 90,8 ± 12,4 | 88,8 ± 11,6 | 2,15 ± 0,6 |
| Mean for Marion Island | | 25 | | 86,4 ± 16,6 | 84,2 ± 16,8 | 2,70 ± 1,8 |
| Mean for all samples | | 33 | | 85,0 ± 27,1 | 82,6 ± 26,8 | 3,03 ± 1,9 |

Although the dissection techniques, weighing equipment and animals were similar in the Gough and Marion samples, a significant difference existed between the percentage weight loss for these two samples (Mann-Whitney Statistic, $U = 63{,}0$; $p < 0{,}004$). As the difference in percentage weight loss between Gough and Marion male *A. tropicalis* was not significant ($U = 24{,}5$; $p > 0{,}05$) it would seem that the inclusion of the smaller females in the Gough sample only, which showed the highest percentage weight loss (Table 1), has biased the comparison. However, there is no significant correlation between whole body mass and percentage weight loss (Kendalls rank correlation $\tau = -0{,}2027$; $p > 0{,}05$) which invalidates body size influences on percentage weight loss in the present instance. Neither was there, contrary to expectations, a significant correlation between the absolute whole body mass and weight loss values ($r = 0{,}2271$; $p > 0{,}1$; $n = 33$).

Factors influencing the extent of body fluid drainage and desiccation rates such as dissection techniques (number and size of portions, surface area exposed and duration of exposure before weighing) and the physical environmental conditions (ambient temperature, solar radiation, relative humidity and convection) are therefore responsible. Since dissection techniques within each particular study were constant, it follows that not only different weather regimes according to latitude, for example, but also fluctuations in environmental factors within a particular study area, influence percentage weight loss determinations.

In view of the above considerations and the conflicting weight loss allowances made for large mammals weighed piecemeal, it is suggested that a correction factor should be determined for each study. For the *Arctocephalus* spp. in the present study this correction factor is certainly much less than that recommended by the American Society of Mammalogists (1976).

## Acknowledgements

This work was done under the auspices of the Mammal Research Institute of the University of Pretoria. We thank the Department of Transport for financial and logistic support on the advice of SASCAR. The field assistance of A. Seabrook and J. Karnezos is gratefully acknowledged.

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