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BODY WATER CONTENT IN MARINE BIRDS

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Total body water (TBW) in adult birds averages approximately 60% of body weight, regardless of bird size (Skadhauge 1981:3). Voluminous data on land and aquatic birds have been obtained using two techniques: oven drying to constant weight and isotope or dye dilution. These techniques yield similar results (Degen et al. 1981). However, Ruch and Hughes (1975) and Walter and Hughes (1978), using isotope dilution, found very high values of TBW of 79% and 88%, respectively, in age-unspecified (presumably adult) Glaucous-winged Gulls (*Larus glaucescens*). They postulated that "the larger TBW volume may be of adaptive significance to marine birds since a larger relative volume would buffer the impact of a salt load on the concentrations of body fluids" (Walter and Hughes 1978). At that time, with the exception of one tern species (see Table 1), their data were apparently the only published values of TBW for marine birds.

A high proportion of body water occurs in aquatic invertebrates (Prosser 1973:7). Documenting such a similar occurrence in marine birds would be of broad interest, particularly because it would open the question of how a bird composed of 80% or more body water could remain a functional flying organism. Young birds do have TBW approximately 80%; however, this decreases with age, reaching adult levels at about fledging (e.g., Dunn 1975, Ricklefs and White 1981, Mahoney and Jehl 1982).

In this note we present and synthesize data from 22 species of marine and aquatic birds to test whether high body water may be "a general phenomenon among birds which live in a marine environment" (Walter and Hughes 1978). A review of the published data on TBW of birds was published by Skadhauge (1981), and Williams et al. (1982) have recently provided extensive data on water content of eggs and hatchlings in a variety of seabirds.

Most of our data were obtained from healthy (except where otherwise noted) adult birds that were freshly-collected over the course of a year in southern California or at Mono Lake, Mono Co., Ca., a hypersaline lake where total dissolved solids approximate 85–90‰. We also used some birds found freshly-dead because our earlier studies revealed no difference in body water content of birds freshly-dead and those collected (see data for Eared Grebe, *Podiceps nigricollis,* in Table 1). We weighed each bird after removing its stomach contents, opened the body cavity to insure complete desiccation and dried the carcass to constant weight in a drying oven at 80°C. Determining TBW this way does not correct for differences in body fat or possible loss of volatile fats in the drying process. A high percentage of fat would tend to underestimate TBW; loss of volatile fatty acids would slightly overestimate TBW. The errors in each case are small, and tend to cancel each other.

Our results and those of others (Table 1) show that TBW of 22 species of aquatic and marine birds, including four gulls, approximates 60% and is similar to that of other birds, both land and aquatic species (see Skadhauge 1981: Tables 1.1 and 1.2). This indicates that marine birds have no special adaptation for retaining high levels of body water. We agree with Skadhauge (1981:5) that anomalous values determined via dilution techniques should be considered with skepticism.

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LITERATURE CITED

DEGEN, A. A., B. PINSHOW, P. U. ALKON, AND H. ARNON. 1981. Tritiated water for estimating total body water and water turnover rate in birds. J. Appl. Physiol. 51: 1183–1188.

DUNN, E. H. 1975. Growth, body components and energy content of nestling Double-crested Cormorants. Condor 77:431–438.

JOHNSTON, D. W. 1964. Ecologic aspects of lipid deposition in some post-breeding arctic birds. Ecology 45: 848–852.

MAHONEY, S. A., AND J. R. JEHL, JR. 1982. Physiological ecology of California Gulls at Mono Lake, California. Hubbs-Sea World Research Institute Technical Report No. 82–148.

PROSSER, C. L. 1973. Comparative animal physiology. 3rd ed. W. B. Saunders Co., Philadelphia.

PURDUE, J. R., AND H. HAINES. 1977. Salt tolerance and water turnover in the Snowy Plover. Auk 94:248–255.

RAVELING, D. G. 1979. The annual cycle of body composition of Canada Geese with special reference to control of reproduction. Auk 96:234–252.

RICKLEFS, R. E., AND S. C. WHITE. 1981. Growth and energetics of chicks of the Sooty Tern (*Sterna fuscata*) and Common Tern (*S. hirundo*). Auk 98:361–378.

RUCH, F. E., JR., AND M. R. HUGHES. 1975. The effects of hypertonic sodium chloride injection on body water distribution in ducks (*Anas platyrhynchos*), gulls (*Larus glaucescens*), and roosters (*Gallus domesticus*). Comp. Biochem. Physiol. 52:21–28.

SKADHAUGE, E. 1981. Osmoregulation in birds. Springer-Verlag, New York.

WALTER, A., AND M. R. HUGHES. 1978. Total body water volume and turnover rate in fresh water and sea water adapted Glaucous-winged Gulls (*Larus glaucescens*). Comp. Biochem. Physiol. 61:233–237.

WILLIAMS, A. J., W. R. SIEGFRIED, AND J. COOPER. 1982. Egg composition and hatchling precocity in seabirds. Ibis 124:456–470.

YARBOROUGH, C. G. 1970. Summer lipid levels of some subarctic birds. Auk 87:100–110.

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TABLE 1. Percent total body water (TBW) of marine and aquatic birds.

Species	*n*	Body weight (g)		TWB		Method	Source
		Range	Mean	Range	Mean		
Gavia arctica[a]	1		1,048		59.4	drying	present study
Podiceps nigricollis	3	265–366	316	60.4–69.6	64.9	drying	present study
P. nigricollis[a]	6	149–268	206	63.4–68.4	65.6	drying	present study
Fulmarus glacialis[a]	1		392		64.8	drying	present study
Branta canadensis minima	83	950–1,705	1,347	54.0–64.4	60.5	drying	Raveling 1979
Pluvialis dominica	7	134–156	148	59.3–65.3	62.5	drying	Johnston 1964
Charadrius alexandrinus	4		34		69.6	isotope dilution	Purdue and Haines 1977
Calidris pusilla	3		24		58.5	isotope dilution	Purdue and Haines 1977
C. mauri	6	25–31	28	53.9–61.9	57.7	drying	Johnston 1964
C. minutilla	47	19–30	23	59.7–64.3	62.3	drying	Yarborough 1970
C. alpina	42	46–71	57	56.9–69.7	63.0	drying	Yarborough 1970
Phalaropus tricolor	30	44–77	59	51.2–67.3	61.0	drying	present study
P. lobatus	10	30–41	32	50.2–69.9	59.4	drying	present study
P. fulicaria[a]	1		27		64.2	drying	present study
Larus heermanni	1		394		60.2	drying	present study
L. delawarensis	4	376–553	444	52.5–61.5	59.8	drying	present study
L. californicus	9	512–760	601	58.0–66.5	61.9	drying	Mahoney and Jehl 1982
L. californicus[c]	15	287–737	451	50.5–66.8	59.2	drying	Mahoney and Jehl 1982
L. occidentalis	6	660–908	816	55.7–61.5	59.8	drying	present study
L. glaucescens	2		835		87.9	isotope dilution	Ruch and Hughes 1975
L. glaucescens	6		787		79.3	isotope dilution	Walter and Hughes 1978
Sterna hirundo	2		112[b]		59.9	drying	Ricklefs and White 1981
S. paradisaea	19	96–119	108	48.5–61.7	57.0	drying	Johnston 1964
S. fuscata	2		177[b]		61.2	drying	Ricklefs and White 1981
Uria aalge[a]	2	539, 498	519	67.6–67.9	67.8	drying	present study

[a] Found freshly-dead.
[b] Authors state that these weights were the "sum of all body components and therefore slightly less than preprocessing weight."
[c] Immature birds.