

# The weights of some southern African Anatidae

W. R. J. DEAN and DAVID M. SKEAD

## Introduction

Since 1955, at the Barberspan Ornithological Research Station, weights have been taken of all waterfowl trapped for ringing. The study area, a shallow alkaline lake, is situated in the western Transvaal, South Africa, at 26°33'S, 25°36'E, and has been described by Milstein (1975).

This paper presents the results of analyses of the weight data for Cape Shelduck *Tadorna cana*, Yellow-billed Duck *Anas undulata*, Red-billed Teal *A. erythrorhyncha* and Southern Pochard *Netta erythrophthalma*. Other data on weights of Yellow-billed Duck have been published by Shewell (1959), Rowan (1963) and Day (1977), on Red-billed Teal by Douthwaite (1976) and Day (1977), and on Southern Pochard by Middlemiss (1958).

## Method

Waterfowl were weighed on a Mettler electric balance during routine waterfowl ringing. Only weight data from first captures have been used. These data have been analysed using a CDC Cyber 174 computer to calculate monthly means and variances for each month during the period January 1972 to December 1976.

The plumages of all Anatidae handled at Barberspan are examined for feather condi-

tion, and classified into 'old plumage', 'growing plumage' (during the flightless moult), and 'new plumage'. The weights of individuals of each species that were in the flightless moult have been analysed separately, and regression lines, showing a progressive decline in weight from old plumage and through the moult stages, have been computed by an analysis of variance in regression (Simpson *et al.* 1960). The weights of Yellow-billed Duck pre-moult and post-moult, and of Red-billed Teal post-moult were excluded from the data sub-sets when the regression lines were calculated.

## Results

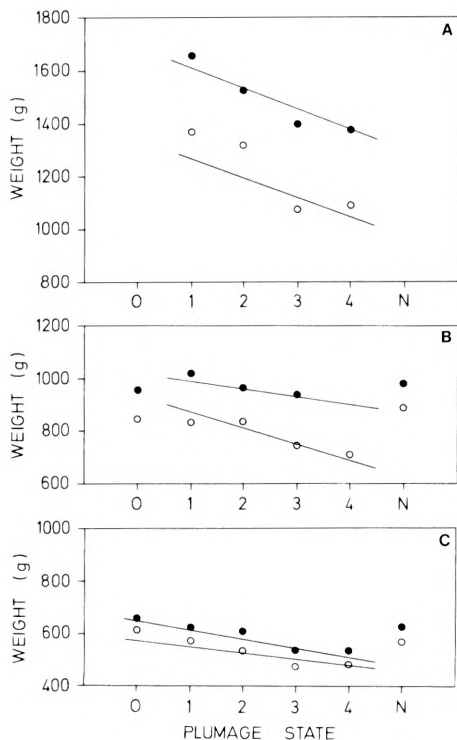
### Cape Shelduck *Tadorna cana*

The mean weight of Cape Shelduck for the period September to April are given in Table 1. Weights are highest during October in both sexes and lowest during January.

The overall mean weight of males is significantly greater than that of females. Mean weights of juvenile (first year) males and females are significantly less than adult weights, the males being significantly heavier than females. The weights of both sexes during flightless moult are given in Figure 1a, which also shows the regression lines fitted to the mean weights during feather growth stages.

Table 1. Mean weights in grams of Cape Shelduck at Barberspan during the period January 1972 to December 1976.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad ♂ n	60	24	7						4	13	11	50
Mean	1,474	1,504	1,475						1,487	1,726	1,640	1,539
Ad ♀ n	60	31	8						5	16	20	75
Mean	1,202	1,208	1,134						1,153	1,345	1,312	1,228
Juv ♂ n												6
Mean												1,289
Juv ♀ n												6
Mean												1,050
	n	Mean	S.D.	Range								
Ad ♂	171	1,527	170.13	1,032-2,032	Ad ♂	Ad ♀	t = 231.55	p < 0.001				
Ad ♀	215	1,229	147.93	872-1,835	Juv ♂	Juv ♀	t = 108.66	p < 0.001				
Juv ♂	6	1,289	17.74	1,135-1,481	Ad ♂	Juv ♂	t = 44.51	p < 0.001				
Juv ♀	6	1,050	11.29	760-1,332	Ad ♀	Juv ♀	t = 35.94	p < 0.001				



**Figure 1.** The mean weights of ducks during the flightless moult. Solid dots are males, and open dots are females. Plumage states are: O = old plumage, 1,2,3,4, = successive states in remige growth, N = new plumage.

A. Cape Shelduck. The regression lines have the following equations:

$$\delta \delta y = -117.49x + 1,765.47 (r = -0.92)$$

$$\text{♀} \text{♀} y = -104.65x + 1,413.38 (r = -0.92)$$

B. Yellow-billed Duck.

$$\delta \delta y = -38.33x + 1,048.37 (r = -0.92)$$

$$\text{♀} \text{♀} y = -46.03x + 895.16 (r = -0.90)$$

C. Red-billed Teal.

$$\delta \delta y = -49.72x + 681.82 (r = -0.91)$$

$$\text{♀} \text{♀} y = -36.19x + 598.14 (r = -0.89)$$

#### Yellow-billed Duck *Anas undulata*

The mean weights of Yellow-billed Duck are summarized in Table 2. Mean weight differences between sexes and between ages were again significant. The weights during flightless moult progressively decline from, in males, 1,018 g when the remiges are still pins, to 937 g when the remiges are about half-grown (Figure 1b). We have no data on the weights of males at a later stage in the

moult cycle. In females, the decline in weight during flightless moult shows a similar trend to that of females, but the regression line suggests that the weight loss is relatively greater at a similar feather growth stage.

#### Red-billed Teal *Anas erythrorhyncha*

Table 3 summarizes the weight data. Again, sex and age differences in mean weights were significant. Pre-moult, moult and post-moult weights in both males and females show similar trends to the first two species, with a progressive decline in weight from old plumage to the end of the remige growth period, and an increase in weight after moult (Figure 1c).

#### Southern Pochard *Netta erythrophthalma*

The mean weights of male and female Southern Pochard are given in Table 4. Age and sex differences in mean weights were significant.

The sample of flightless Southern Pochard weights was too small to permit any statistical analyses. The indications are, however, for a progressive decline in weight by both sexes, analogous to the other three species.

## Discussion

Cape Shelduck make an annual migration to Barberspan specially to moult (Shewell 1959; Milstein 1975; Skead & Dean 1977b) and arrive heavier than the overall mean weight, and depart in February/March below the overall mean weight.

The mean weights of both male and female Yellow-billed Ducks do not fluctuate markedly throughout the year. There is a tendency for male weights to be highest after the breeding season and during the dry season, but the difference between maximum and minimum mean weights is not great (Table 2). Female weights are highest during the dry season and before the breeding season, but again, the difference is not large. Weights in both sexes tended to be lowest during the early part of the breeding season, which is mainly December–May in this area (Skead & Dean 1977a), supporting the findings of Rowan (1963), who showed that the weights of (unsexed) Yellow-billed Ducks at Rondevlei, Cape Province, were lowest during the breeding season of July–September.

There are no marked fluctuations in the

**Table 2. Mean weights in grams of Yellow-billed Duck at Barberspan during the period January 1972 to December 1976.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad ♂ n	977	544	270	90	309	281	455	843	1,041	837	1,223	973
Mean	927	932	922	1,001	1,002	972	974	989	991	983	960	942
Ad ♀ n	728	394	212	76	296	306	447	636	798	686	880	625
Mean	791	801	843	799	808	805	836	835	839	839	828	826
Juv ♂ n	6	5	5	2	39	84	130	213	148	73	26	10
Mean	758	744	760	929	738	834	867	869	861	820	809	873
Juv ♀ n	1	3	6	3	44	46	81	96	37	37	7	9
Mean	582	559	658	558	604	669	677	719	702	781	714	692
	n	Mean	S.D.	Range								
Ad ♂	7,839	965	33.97	533-1,310		Ad ♂	Ad ♀	t= 1,481.39		p<0.001		
Ad ♀	6,080	823	28.23	600-1,123		Juv ♂	Juv ♀	t= 289.61		p<0.001		
Juv ♂	737	844	58.52	556-1,153		Ad ♂	Juv ♂	t= 522.86		p<0.001		
Juv ♀	363	694	78.91	424- 929		Ad ♀	Juv ♀	t= 428.27		p<0.001		

**Table 3. Mean weights in grams of Red-billed Teal at Barberspan during the period January 1972 to December 1976.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad ♂ n	95	51	21	8	89	85	256	307	240	52	118	32
Mean	564	568	559	597	626	600	601	595	549	617	586	597
Ad ♀ n	48	29	4	4	52	52	258	354	113	46	83	38
Mean	545	520	482	441	577	538	550	548	561	588	550	556
Juv ♂ n					13	31	60	146	48			
Mean					397	510	551	582	538			
Juv ♀ n					9	44	24	24	7			
Mean					346	392	476	461	412			
	n	Mean	S.D.	Range								
Ad ♂	1,366	591	33.41	345-954		Ad ♂	Ad ♀	t= 191.74		p<0.001		
Ad ♀	1,177	544	43.30	338-955		Juv ♂	Juv ♀	t= 155.96		p<0.001		
Juv ♂	306	532	34.22	288-730		Ad ♂	Juv ♂	t= 2,546.19		p<0.001		
Juv ♀	111	431	33.99	273-597		Ad ♀	Juv ♀	t= 174.56		p<0.001		

**Table 4. Mean weights in grams of Southern Pochard at Barberspan during the period January 1972 to December 1976.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad ♂ n	20	26	83	47	47	33	68	64	43	32	27	47
Mean	813	826	794	780	787	757	809	799	799	817	784	812
Ad ♀ n	14	11	44	35	46	29	60	84	58	32	22	28
Mean	767	772	743	828	755	741	741	788	774	743	736	789
Jun ♂ n						9	29	36	28	4		
Mean						693	702	720	736	782		
Juv ♀ n					6	31	14	10	8			
Mean					658	640	639	640	764			
	n	Mean	S.D.	Range								
Ad ♂	577	799	84.27	592-1,010		Ad ♂	Ad ♀	t= 64.86		p<0.001		
Ad ♀	463	763	72.76	484-1,018		Juv ♂	Juv ♀	t= 47.27		p<0.001		
Juv ♂	108	715	70.56	512- 957		Ad ♂	Juv ♂	t= 88.41		p<0.001		
Juv ♀	69	656	57.76	506- 886		Ad ♀	Juv ♀	t= 98.52		p<0.001		

monthly mean weights of Red-billed Teal males, and similar trends to the weights of Yellow-billed Duck are shown. Females of the two species also showed similar trends. The trends shown by the weights of Red-billed Teal are similar to those of this species on the Kafue flats, Zambia (Douthwaite 1976).

Southern Pochard male and female mean weights do not show marked fluctuations during the year. Both sexes tend to be below average weight during the dry season.

A progressive loss in weight during the flightless moult of several southern African anad species has been suggested or shown by Middlemiss (1958), Shewell (1959), Rowan (1963) and Douthwaite (1976). The weight loss by the Red-billed Teal during moult may be adaptive, enabling them to fly before the remiges are fully grown (Douthwaite 1976). This may apply to other southern African Anatidae, and a progressive decline in weight during moult, would be an effective method of reducing the flightless period, assuming that feather growth rates are fixed by metabolic processes and cannot be increased.

Weights of Yellow-billed Duck and Red-billed Teal show the general trend of being greater during the dry season and lesser during the wet season, while weights of the Southern Pochard tend to be greater during the wet season. The first two species are dabblers, while the southern Pochard is a diver. Temporal fluctuations and differences in the quality and quantity of food taken by dabblers and divers possibly influence the peak weights of the birds.

### Summary

Weights of male and female Cape Shelduck *Tadorna cana*, Yellow-billed Duck *Anas undulata*, Red-billed Teal *A. erythrorhynca* and Southern Pochard *Netta erythrophthalma* were taken at Barberspan, South Africa, from January 1972 to December 1976. These are significant differences in mean weights between sexes and between adults and juveniles. Weights do not vary markedly during the year. The first three species progressively lose weight during the flightless moult and gain immediately the moult has been completed. There are insufficient data for flightless Southern Pochard.

### References

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## Method

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The plumages of all Anatidae handled at Barberspan are examined for feather condi-

tion, and classified into 'old plumage', 'growing plumage' (during the flightless molt), and 'new plumage'. The weights of individuals of each species that were in the flightless molt have been analyzed separately, and regression lines, showing a progressive decline in weight from old plumage and through the molt stages, have been computed by an analysis of variance in regression (Simpson *et al.* 1960). The weights of Yellow-billed Duck pre-molt and post-molt, and of Red-billed Teal post-molt were excluded from the data subsets when the regression lines were calculated.

## Results

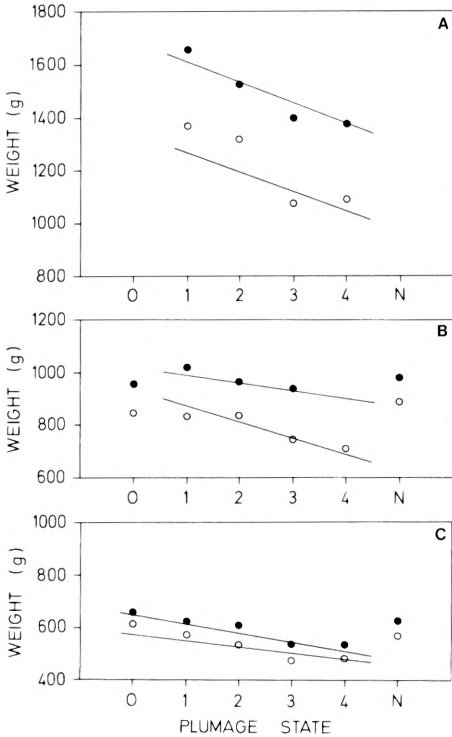
### Cape Shelduck *Tadorna cana*

The mean weights of Cape Shelduck for the period September to April are given in Table 1. Weights are highest during October in both sexes and lowest during January.

The overall mean weight of males is significantly greater than that of females. Mean weights of juvenile (first-year) males and females are significantly less than adult weights, the males being significantly heavier than females. The weights of both sexes during flightless molt are given in Figure 1a, which also shows the regression lines fitted to the mean weights during feather-growth stages.

**Table 1. Mean weights in grams of Cape Shelduck at Barberspan during the period January 1972 to December 1976.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad <i>n</i>	60	24	7						4	13	11	50
Mean	1474	1504	1475						1487	1726	1640	1539
Ad <i>n</i>	60	31	8						5	16	20	75
Mean	1202	1208	1134						1153	1345	1312	1228
Juv <i>n</i>												6
Mean												1289
Juv <i>n</i>												6
Mean												1050
	<i>n</i>	Mean	S.D.	Range								
Ad	171	1527	170.13	1032-2032	Ad	Ad	<i>t</i> = 231.55	<i>P</i> < 0.001				
Ad	215	1229	147.93	872-1835	Juv	Juv	<i>t</i> = 108.66	<i>P</i> < 0.001				
Juv	6	1289	17.74	1135-1481	Ad	Juv	<i>t</i> = 44.51	<i>P</i> < 0.001				
Juv	6	1050	11.29	760-1332	Ad	Juv	<i>t</i> = 35.94	<i>P</i> < 0.001				



**Figure 1.** The mean weights of ducks during the flightless molt. Solid dots are males and open dots are females. Plumage states are: O = old plumage, 1, 2, 3, 4 = successive states in remiges growth, N = new plumage.

A. Cape Shelduck. The regression lines have the following equations:

$$y = -117.49x + 1765.47 \quad (r = -0.92)$$

$$y = -104.65x + 1413.38 \quad (r = -0.92)$$

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$$y = -49.72x + 681.82 \quad (r = -0.91)$$

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#### Yellow-billed Duck *Anas undulata*

The mean weights of Yellow-billed Duck are summarized in Table 2. Mean weight differences between sexes and between ages were again significant. The weights during flightless molt progressively decline from, in males, 1018 g, when the remiges are still pins, to 937 g when the remiges are about half-grown (Figure 1b). We have no data on the weights of males at a later stage in the

molt cycle. In females, the decline in weight during flightless molt shows a similar trend to that of females, but the regression line suggests that the weight loss is relatively greater at a similar feather growth stage.

#### Red-billed Teal *Anas erythrorhyncha*

Table 3 summarizes the weight data. Again, sex and age differences in mean weights were significant. Pre-molt, molt and post-molt weights in both males and females show similar trends to the first two species, with a progressive decline in weight from old plumage to the end of the remiges growth period, and an increase in weight after molt (Figure 1c).

#### Southern Pochard *Netta erythrophthalma*

The mean weights of male and female Southern Pochard are given in Table 4. Age and sex differences in mean weights were significant.

The sample of flightless Southern Pochard weights was too small to permit any statistical analyses. The indications are, however, for a progressive decline in weight by both sexes, analogous to the other three species.

### Discussion

Cape Shelduck make an annual migration to Barberspan, specially to molt (Shewell 1959; Milstein 1975; Skead & Dean 1977b) and arrive heavier than the overall mean weight, and depart in February/March below the overall mean weight.

The mean weights of both male and female Yellow-billed Ducks do not fluctuate markedly throughout the year. There is a tendency for male weights to be highest after the breeding season and during the dry season, but the difference between maximum and minimum mean weights is not great (Table 2). Female weights are highest during the dry season and before the breeding season, but again, the difference is not large. Weights in both sexes tended to be lowest during the early part of the breeding season, which is mainly December–May in this area (Skead & Dean 1977a), supporting the findings of Rowan (1963), who showed that the weights of (unsexed) Yellow-billed Ducks at Rondevlei, Cape Province, were lowest during the breeding season of July–September.

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Ad <i>n</i>	728	394	212	76	296	306	447	636	798	686	880	625
Mean	791	801	843	799	808	805	836	835	839	839	828	826
Juv <i>n</i>	6	5	5	2	39	84	130	213	148	73	26	10
Mean	758	744	760	929	738	834	867	869	861	820	809	873
Juv <i>n</i>	1	3	6	3	44	46	81	96	37	37	7	9
Mean	582	559	658	558	604	669	677	719	702	781	714	692
	<i>n</i>	Mean	S.D.	Range			Ad	Ad	<i>t</i> = 1481.39	<i>P</i> < 0.001		
Ad	7839	965	33.97	533–1310			Ad	Ad	<i>t</i> = 289.61	<i>P</i> < 0.001		
Ad	6080	823	28.23	600–1123			Juv	Juv	<i>t</i> = 522.86	<i>P</i> < 0.001		
Juv	737	844	58.52	556–1153			Ad	Juv	<i>t</i> = 428.27	<i>P</i> < 0.001		
Juv	363	694	78.91	424–929			Ad	Juv				

**Table 3.** Mean weights in grams of Red-billed Teal at Barberspan during the period January 1972 to December 1976.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad <i>n</i>	95	51	21	8	89	85	256	307	240	52	118	32
Mean	564	568	559	597	626	600	601	595	549	617	586	597
Ad <i>n</i>	48	29	4	4	52	52	258	354	113	46	83	38
Mean	545	520	482	441	577	538	550	548	561	588	550	556
Juv <i>n</i>					13	31	60	146	48			
Mean					397	510	551	582	538			
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Ad	1366	591	33.41	345–954			Ad	Ad	<i>t</i> = 155.96	<i>P</i> < 0.001		
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Juv	111	431	33.99	273–597			Ad	Juv				

**Table 4.** Mean weights in grams of Southern Pochard at Barberspan during the period January 1972 to December 1976.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ad <i>n</i>	20	26	83	47	47	33	68	64	43	32	27	47
Mean	813	826	794	780	787	757	809	799	799	817	784	812
Ad <i>n</i>	14	11	44	35	46	29	60	84	58	32	22	28
Mean	767	772	743	828	755	741	741	788	774	743	736	789
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	<i>n</i>	Mean	S.D.	Range			Ad	Ad	<i>t</i> = 64.86	<i>P</i> < 0.001		
Ad	577	799	84.27	592–1010			Ad	Ad	<i>t</i> = 47.27	<i>P</i> < 0.001		
Ad	463	763	72.76	484–1018			Juv	Juv	<i>t</i> = 88.41	<i>P</i> < 0.001		
Juv	108	715	70.56	512–957			Ad	Juv	<i>t</i> = 98.52	<i>P</i> < 0.001		
Juv	69	656	57.76	506–886			Ad	Juv				

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### References

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