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ASYMMETRIC MOLT OR FEATHER WEAR IN FLYING STEAMER DUCKS (*TACHYERES PATACHONICUS*) FROM COASTAL HABITATS IN ARGENTINA

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Muda asimétrica o desgaste de plumas en el Pato Vapor Volador (*Tachyeres patachonicus*) de hábitos costeros en Argentina.

Key words: Molt, feather wear, Steamer Duck, *Tachyeres,* Argentina.

INTRODUCTION

Molting is a time and energy consuming activity (Payne 1972, Murphy & King 1991). Increased energetic demands and reduced aerodynamic or swimming efficiency may impose foraging difficulties for birds and lead to increased vulnerability to predators or inclement weather (Payne 1972, King 1981, Walsberg 1983, Langston & Rohwer 1995). As a result, most birds do not molt and breed at the same time. Additionally, most birds exhibit a molt pattern that maintains flight ability, with the main exception being waterfowl. Most waterfowl exhibit a complete molt and become flightless for a period of time. Many migratory duck species migrate to molting areas prior to migration, which is presumed to reduce predation risk (Hohman *et al.* 1992). In contrast, resident and flightless species of other birds breeding in the tropics typically undergo a prolonged molt that minimizes the daily energetic cost of a complete molt. Prolonged molt presumably arose due to the lack of strong seasonal constraints on breeding. Gradual feather replacement imposes the least metabolic stress on an individual and is sufficient to offset normal seasonal wear (Gill 1995).

Steamer ducks (*Tachyeres* spp.) are endemic to the southern cone region of South America (Argentina, Chile, Falkland Islands) and are unusual among waterfowl because they include both flying and flightless species. Three species are completely flightless (Falkland Island Steamer Duck *T. brachypterus*, Magellanic Flightless Steamer Duck *T. pteneres,* and White-headed Flightless Steamer Duck *T. leucocephalus*) and are restricted to allopatric coastal habitats (Livezey & Humphrey 1992). The range of the Flying Steamer Duck (*T. patachonicus*) overlaps with the three flightless steamer ducks. However, some individuals from coastal regions are known to be incapable of

TABLE 1. Localities, habitat type, sex, age, mass, wing area, and wing loadings of steamer ducks (*Tachyeres* spp.) collected in Argentina.

Catalog no.	Species	Locality	Habitat	Sex	Age	Mass (g)	Wing area (cm^{2})	Wing loading (g/cm^{2})
UAM 22621 (KGM768)	*Tachyeres patachonicus*	Santa Cruz, Estancia La Angostura, 48°37'12.7"S, 70°41'48.3"W, 408 m	Inland	M	Ad	3000	1280.32	2.34
UAM 22625 (KGM773)	*Tachyeres patachonicus*	Santa Cruz, Laguna del Pescado, 49°07'30.9"S, 72°55'41.1W, 466 m	Inland	M	Ad	2350	1198.63	1.96
UAM 20715 (KGM804)	*Tachyeres patachonicus*	Santa Cruz, c. Puerto Santa Cruz, 50°03'51.5"S, 68°30'01.2"W, 0 m	Coastal	M	Ad	2750	1250.60	2.20
UAM 22624 (KGM805)	*Tachyeres patachonicus*	Santa Cruz, c. Puerto Santa Cruz, 50°03'51.5"S, 68°30'01.2"W, 0 m	Coastal	F	Ad	2100	1162.78	1.81
UAM 20714 (KGM807)	*Tachyeres patachonicus*	Santa Cruz, Puerto Deseado, 47°45'18.0"S, 65°53'06.4"W, 0 m	Coastal	M	Ad	3250	1308.30	2.48
UAM 20799 (KGM817)	*Tachyeres patachonicus*	Chubut, N. Caleta Cordova, 45°43'34.1"S, 67°21'42.2"W, 0 m	Coastal	F	Ad	2250	1184.64	1.90
UAM 22623 (KGM818)	*Tachyeres patachonicus*	Chubut, N. Caleta Cordova, 45°43'34.1"S, 67°21'42.2"W, 0 m	Coastal	M	Ad	3200	1302.83	2.46
UAM 22622 (KGM819)	*Tachyeres leucocephalus*	Chubut, Bahia Bustamante, 45°08'05.2"S, 66°32'06.1"W, -3 m	Coastal	M	Ad	4450	1424.15	3.12
UAM 20801 (KGM822)	*Tachyeres leucocephalus*	Chubut, N. Camarones, 44°45'26.0"S, 65°41'43.1"W, 0 m	Coastal	F	Ad	3800	1364.71	2.78
UAM 20800 (KGM823)	*Tachyeres leucocephalus*	Chubut, N. Camarones, 44°45'26.0"S, 65°41'43.1"W, 0 m	Coastal	M	Ad	4400	1419.81	3.10

[1]Calculated using wing area equation for steamer ducks from Humphrey & Livezey (1982); Wing area = $147.4 \cdot \text{Weight}^{0.27}$.

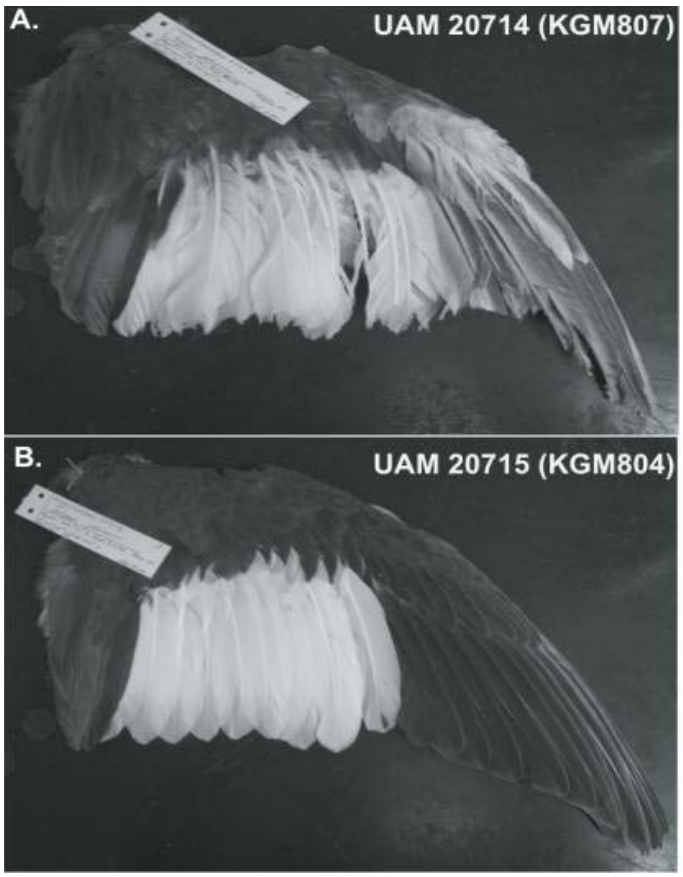

FIG. 1. Spread wings of Flying Steamer Ducks (*Tachyeres patachonicus*) showing different stages of feather wear. University of Alaska Museum (UAM) catalog numbers and the collector field catalog numbers are given in the upper right corner of each photo.

flight because of their large body mass and unusually heavy wing-loading (> 2.5g/cm^2; Humphrey & Livezey 1982, Livezey & Humphrey 1992).

Livezey & Humphrey (1992) reported that the White-headed Steamer Duck and Magellanic Steamer Duck have two annual molts and that the Flying Steamer Duck has three molts per annual cycle. Moreover, Livezey & Humphrey (1992) found that there is considerable geographic variation in molt in the Flying Steamer Duck, which leads to the possibility that unusual molting patterns may be more common. In this paper, we describe an unusual pattern of feather wear on the primaries and secondaries of Flying Steamer Ducks.

METHODS

We collected seven Flying Steamer Ducks and three White-headed Steamer Ducks from Chubut and Santa Cruz, Argentina, between 17 October and 10 November 2003 (Table 1). Wing area and wing loading were calculated using the wing

TABLE 2. Feather wear condition for individual primaries of steamer ducks (*Tachyeres* spp.) collected in Argentina.

Catalog No.	Species	Primaries[1]									
		1	2	3	4	5	6	7	8	9	10
UAM 22621 (KGM768)	*Tachyeres patachonicus*	N	N	N	N	IW	MW	MW	MW	MW	N
		N	N	N	N	IW	MW	MW	MW	MW	N
UAM 22625 (KGM773)	*Tachyeres patachonicus*	N	N	N	N	N	N	N	N	N	N
		N	N	N	N	N	N	N	N	N	N
UAM 20715 (KGM804)	*Tachyeres patachonicus*	IW	IW	IW	IW	IW	MW	MW	MW	MW	MW
		IW	IW	IW	IW	IW	MW	MW	MW	MW	MW
UAM 22624 (KGM805)	*Tachyeres patachonicus*	IW	IW	IW	IW	IW	W	MW	MW	MW	MW
		IW	IW	IW	IW	IW	B	MW	MW	MW	MW
UAM 20714 (KGM807)	*Tachyeres patachonicus*	IW	IW	IW	MW	MW	MW	MW	W	W	W
		B	B	R	R	R	VW	VW	VW	VW	VW
UAM 20799 (KGM817)	*Tachyeres patachonicus*	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
		VW	VW	VW	VW	VW	VW	VW	VW	VW	VW
UAM 22623 (KGM818)	*Tachyeres patachonicus*	MW	MW	MW	MW	W	W	W	W	W	W
		MW	MW	MW	MW	W	W	W	W	W	W
UAM 22622 (KGM819)	*Tachyeres leucocephalus*	W	W	W	W	W	VW	W	W	W	W
		MW	MW	MW	MW	W	W	W	W	W	W
UAM 20801 (KGM822)	*Tachyeres leucocephalus*	N	N	N	N	N	N	N	N	IW	N
		N	N	N	N	N	N	N	N	N	N
UAM 20800 (KGM823)	*Tachyeres leucocephalus*	W	W	W	W	W	W	W	W	W	IW
		MW	MW	MW	MW	W	W	W	W	W	W

[1] Left wing primaries are in top row and right wing primaries in bottom row for each individual. Feathers classified as: N = new, IW = intermediate wear, MW = moderate wear, W = worn, VW = very worn, R = worn to rachis, MIS = missing, B = broken.

area equation from Humphrey & Livezey (1982; Wing area = $147.4 \cdot \text{Weight}^{0.27}$) to determine if each specimen had the capacity for sustained flight, as each individual was not seen flying prior to collection. Wing and feather wear patterns were examined during specimen preparation at the University of Alaska Museum. The states of wear on the primaries and secondaries were categorized as follows, using feather wear patterns described by Summers & Martin (1985): N = new feathers that showed no wear or faded color; IW = intermediate wear; MW = moderate wear; W = worn; VW = very worn; R = feathers worn to the rachis; MIS = missing feather; and B = broken feather. Feather wear was described as: "intermediate wear" if feathers exhibited some wear but did not have faded feather tips as seen in feathers exhibiting moderate wear shown in Summers & Martin (1985; Fig. 2); "feathers worn to the rachis" if feathers were missing all or nearly all of the vane; "missing" if a feather was not present; and "broken" if the rachis was broken.

RESULTS

Calculation of wing loading showed that all Flying Steamer Ducks were capable of sustained flight as wing loadings were below 2.5 g/cm^2 (Table 1). For White-headed Steamer Ducks, wing loadings ranged from 2.78–3.13 g/cm^2, thus, indicating that none of these individuals were capable of sustained flight.

Two basic feather wear patterns were observed in our study; feathers were either worn similarly on both wings or feathers were worn more heavily on one wing than the other wing (Fig. 1, Tables 2 and 3). Feather wear patterns were similar for both wings on four of seven Flying Steamer Ducks [UAM 22621 (KGM768), UAM 22625 (KGM773), UAM 22624 (KGM805), UAM 22623 (KGM818)] and all three White-headed Steamer Ducks [UAM 22622 (KGM819), UAM 20801 (KGM822), UAM 20800 (KGM823)], although the degree of wear differed among individuals. Two individuals (UAM 22625, 20801) had all new feathers on both wings; UAM 22625 was collected at an inland locality in Santa Cruz. Three individuals (UAM 22623, 22622, 20800) had extreme feather wear on both wings, and one individual (UAM 22624) had intermediate to moderate wear on both wings. The other individual (UAM 22621) that had similar wear on both wings had new feathers intermixed with worn primary feathers, suggesting that the individual had just completed a molt cycle or had a molt cycle interrupted.

Feather wear patterns for the remaining three Flying Steamer Ducks [UAM 20715 (KGM804), UAM 20714 (KGM807), UAM 20799 (KGM817)] were more pronounced on one wing relative to the other wing. Two individuals (UAM 20714, 20799) had "moderate" feather wear on the left wing primaries with "new" secondaries and "very worn" or "worn to the rachis" feather wear on the right wing primaries with "intermediate worn" or "worn to the rachis" feather wear on the right wing secondaries. The remaining individual (UAM 20715) had "intermediate" to "moderate" feather wear on the primaries of both wings. In contrast, secondaries on the left wing had "intermediate" or "worn" feathers; whereas, secondaries on the right wing exhibited "moderate" or "worn to the rachis" feather wear.

DISCUSSION

Unusual molt and feather wear patterns have been observed in other birds (albatross: Langston & Rohwer 1995). However, the extreme feather wear pattern we observed in three Flying Steamer Ducks collected in coastal habi-

TABLE 3. Feather wear condition for individual secondaries of steamer ducks (*Tachyeres* spp.) collected in Argentina..

Catalog No.	Species	Secondaries[1]											
		1	2	3	4	5	6	7	8	9	10	11	12
UAM 22621 (KGM768)	*Tachyeres patachonicus*	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW
		IW	IW	IW	IW	IW	IW	MIS	IW	IW	IW	IW	IW
UAM 22625 (KGM773)	*Tachyeres patachonicus*	N	N	N	N	N	N	N	N	N	N	N	N
		N	N	N	N	N	N	N	N	N	N	N	N
UAM 20715 (KGM804)	*Tachyeres patachonicus*	IW	IW	IW	MW	W	W	W	W	IW	IW	IW	IW
		VW	VW	R	R	VW	VW	VW	VW	VW	W	MW	MW
UAM 22624 (KGM805)	*Tachyeres patachonicus*	N	N	N	N	N	IW	IW	IW	IW	IW	IW	IW
		IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW
UAM 20714 (KGM807)	*Tachyeres patachonicus*	N	N	N	N	N	N	N	N	N	N	IW	IW
		IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW
UAM 20799 (KGM817)	*Tachyeres patachonicus*	N	N	N	N	N	N	N	N	N	N	N	N
		R	R	R	MIS	R	VW	MW	MW	MW	MW	MW	MW
UAM 22623 (KGM818)	*Tachyeres patachonicus*	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW
		IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW	IW
UAM 22622 (KGM819)	*Tachyeres leucocephalus*	W	W	W	W	W	W	W	W	W	W	W	W
		W	W	W	W	W	W	W	W	W	W	W	W
UAM 20801 (KGM822)	*Tachyeres leucocephalus*	N	N	N	N	N	N	N	N	N	N	N	N
		N	N	N	N	N	N	N	N	N	N	N	N
UAM 20800 (KGM823)	*Tachyeres leucocephalus*	IW	IW	IW	MW	MIS	MW	MW	MW	MW	MW	W	W
		W	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW

[1] Left wing secondaries are in top row and right wing secondaries in bottom row for each individual. Feathers classified as: N = new, IW = intermediate wear, MW = moderate wear, W = worn, VW = very worn, R = worn to rachis, MIS = missing, B = broken.

tats of Argentina has not yet been described in literature to our knowledge. While we do not completely understand all factors that induce molt in birds, the degree of wear on feathers may play a role in influencing the frequency of molt in species. Lack of pigmentation in feathers has been suggested to cause feathers to wear faster (Gill 1995), which may result in a continual molt pattern. Although Steamer ducks have white secondaries, they have dark gray primary feathers that appear to have exhibited more extensive feather wear than the secondaries. Therefore, lack of pigmentation does not appear to play a major role in the extreme wear patterns we observed in this species.

Another possible explanation is that individuals may favor the use of one wing over the other while foraging or diving causing uneven wear among flight feathers on either wing. The observation that individuals preferentially use one limb over the other has been shown in other avian species (phalaropes: Cooch 1965, parrots: Friedmann & Davis 1938, pigeons: Fisher 1957). Uneven wear in flight feathers between the wings may cause individuals to molt one wing more frequently to maintain foraging/aerodynamic efficiency or maintain extensive feather wear on the preferential wing until the next molt cycle. Predation also might have contributed to this unusual feather wear pattern. Individuals may have been attacked, damaging flight feathers causing the replacement of one wing. Terrestrial, aerial, and aquatic predators prey on Steamer ducks (Livezey & Humphrey 1983, Straneck *et al.* 1983). For example, Straneck *et al.* (1983) reported that, after a killer whale (*Orcinus orca*) attack, only one wing was left bloody and injured. Additionally, one Falkland Island Steamer Duck was reported to have a non-simultaneous wing molt, possibly due to disease (Livezey & Humphrey 1992). However, all of the individuals that we collected were in good condition and showed no signs of recent injury or disease.

Flightless individuals may be more tolerant to extreme feather wear. Among the Flying Steamer Ducks, the two inland specimens (UAM 22621, 22625) contained more new flight feathers (new to intermediate wear) and less asymmetrical wear than individuals inhabiting coastal environments. Furthermore, the three individuals showing the largest asymmetrical feather wear are potentially volant (wing loading < 2.5 g/cm^2) Flying Steamer Ducks from coastal habitats. The ability for flight may be more important for inland populations as flight is necessary to reach foraging areas. Feathers that are very worn may be too costly to maintain flight and therefore detrimental to survival, whereas flightless individuals inhabiting coastal environments may be able to delay feather replacement longer, i.e., retain feathers in poor condition, as heavy feather wear may not reduce an individual's foraging ability enough to be detrimental.

The cause of the molt patterns that we observed could not be determined, and it is unclear whether the feather wear pattern was due to asymmetric feather wear or asymmetric wing molt. These molt patterns may be uncharacteristic of these species, as the general molt pattern of Anatidae is simultaneous wing molt. However, non-simultaneous (sequential) molts, in which feathers are replaced irregularly or in sequential order, do exist in the Ruddy-headed Sheldgoose (*Chloephaga rubidiceps*), Magellan Goose (*C. picta*), and also in the Magpie Goose (Anseranatidae: *Anseranas semipalmata*; Summers 1982, 1983; Summers & Martin 1985, Todd 1997). The steamer ducks that we collected also may have exhibited a non-simultaneous molt, and thus, retained feathers in poor condition. Retention of feathers exhibiting heavy wear has been observed in other steamer duck populations (Murphy 1936), and Ruddy-headed Sheldgoose has been observed to

retain extremely worn feathers even before a minimal migration (Summers 1982). Therefore, feathers in poor condition may not be as detrimental to steamer ducks as what has been thought for other avian species. However, more information on molt cycles and feather wear for steamer ducks is needed, including time of year and body condition.

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