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Evidence of prenuptial moult in the Little Bittern *Ixobrychus minutus*

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Evidence for a partial prenuptial moult in the Little Bittern *Ixobrychus minutus* is reported for the first time, and is based on both live and museum specimens. The prenuptial moult, which is probably undertaken in the African winter quarters shortly before the spring migration, involves body feathers and often some innermost secondaries. The moult pattern is discussed in the context of the Ardeidae and compared with those of other *Ixobrychus* species. Current ageing criteria are also reconsidered.

The moult of the Little Bittern *Ixobrychus minutus* is poorly known (Baker 1993, Cramp & Simmons 1977), because of a lack of information during autumn and winter, when the birds are in their African wintering grounds. What is known with certainty is that the adults undertake a complete post-breeding moult (Bauer & Glutz von Boltzheim 1966, Baker 1993, Cramp & Simmons 1977) and that some birds start the moult of body and some flight feathers in late July when still in Europe. Eventually they interrupt moult during migration and resume it in Africa, where the replacement of the feathers is completed. However, most birds do not start moulting until their arrival in the winter quarters. Furthermore, information on juveniles is scattered, and mainly based on birds held in captivity (von Lukanus 1914). A resident South African subspecies, *Ixobrychus minutus payesii*, moults the innermost 1-7 primaries descendantly, while outer primaries and secondaries are replaced in an irregular manner (Streseman & Streseman 1966). On the basis of these observations, it has been assumed that *I m minutus* moult in the same way (Cramp & Simmons 1977). Juveniles undertake a partial moult, which starts from November to January (Bauer & Glutz von Boltzheim 1966, Baker 1993, Cramp & Simmons 1977) and involves body feathers and some inner secondaries (von Lukanus 1914, Bezzel 1985).

Because of the lack of an accurate description of the moult patterns, ageing criteria have not yet been assessed clearly. According to Baker (1993) a minority of first-year birds can be aged because of the presence of a few retained outer great coverts.

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During a study of the ecology of the Little Bittern in Italy, we observed that a very high proportion of breeding birds had some fresh and glossy secondaries. These feathers might have resulted from a partial pre-nuptial moult which has not previously been described for the Little Bittern. However, it is a likely pattern, especially when considered in light of the moulting patterns of other members of the family Ardeidae, and, in particular, of the American counterpart of the Little Bittern, the Least Bittern *Ixobrychus exilis* (Palmer 1962, Gibbs *et al* 1992).

METHODS

The plumage of both live birds and museum specimens was examined. Live birds were mist-netted at Montepulciano Lake, Italy (43° 06'N 11° 55'E), during 1997-2000, while the skins belonged to the collection of the Natural History Museum, Tring, United Kingdom.

Ringed birds were carefully checked for contrasts between feathers, in colour, gloss and abrasion. A moult score was assigned to each primary and secondary remex following the methods suggested by Ginn & Melville (1983): a score from zero to five, where zero is an old, unmoulted feather and five is a fully grown new feather.

With respect to the museum material, only skins in good condition and with accurate collection data were examined, with the aim of checking the plumage of adult birds during breeding or on northward migration. Even though most specimens were very old, the contrast between feather generations was still clearly visible in the majority.

RESULTS

Out of 21 Little Bitterns ringed, 16 (76%) had at least two remex generations. In particular, secondaries, mostly the innermost ones, clearly belonged to a different and more recent feather generation and contrasted markedly with the rest of the wing feathers. In the males, in which the remiges, mantle and scapulars are all black, the supposed new inner secondaries appeared to have the same degree of gloss as the mantle and scapular feathers, and hence to belong to the same feather generation. Among the birds with new secondaries, 63% (n = 16) showed 3-6 new feathers, while 31% showed 7-13.

The new feathers were asymmetrical (in different positions in the two wings) in 63% of the cases, and symmetrical in the remaining 38%. New feathers were usually in the inner part of the wing (Table 1). Due to bleaching, they clearly belonged to an older generation of feathers, and contrasted with the scapulars and with the back, both showing a higher degree of gloss. Furthermore one bird showed up to three generations of feathers in the wings: new, old and very old.

Among the 18 museum specimens, 17 (94%) showed new secondaries, and only one (6%) showed a uniformly old wing (Table 2). All the birds with new feathers showed between three and six new

Table 1. Moult scores of the remiges of Little Bitterns trapped at Montepulciano Lake, Italy, during the springs 1997, 1998 and 1999. 0 = old feather, 5 = new feather, (0) = very old feather; R = right, L = left. 'R=L' indicates that both wings showed the same moult pattern.

				Secondaries													Primaries										
Ring number	Date	sex	Wing	13	12	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11
T32502	10/5/97	F	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32503	10/5/97	F	R	5	5	5	0	5	0	0	0	0	0	0	(0)	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32504	10/5/97	M	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32505	11/5/97	F	R=L	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32506	24/5/97	F	R	5	5	5	5	0	0	5	0	0	0	5	0	0	5	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	5	0
T32511	05/6/97	M	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32512	13/5/98	F	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32513	17/5/98	M	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32514	05/6/98	M	R=L	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32515	14/6/98	M	R	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32516	15/6/98	M	R	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32517	19/6/98	F	R	5	5	5	5	5	(0	0	0)	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	5	(0	0	0	0	0)	5	0	0	0	0	0	0	0	0	0	0	0	0
T32518	19/6/98	M	R	5	5	5	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	5	5	5	5	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0
T32519	19/6/98	M	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32520	14/7/98	F	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TE1851	02/5/99	F	R=L	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T32517	09/5/99	F	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TE1852	08/6/99	F	R	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TE1857	15/6/99	M	R	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TE1858	15/6/99	M	R	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TC8201	07/7/99	M	R	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

secondaries, and 66% of all the birds showed a symmetrical wing with the new feathers in the same position in the two wings.

The observations on skins were comparable with those made on the living birds, and indeed the proportion of Little Bitterns showing new feathers or homogeneously old wings did not differ between those caught at Montepulciano Lake and the specimens at the Natural History Museum (χ^2 = 1.25, df = 1, P > 0.05). The proportion of birds showing symmetrical versus asymmetrical moult also did not differ between the two groups (χ^2 = 2.6, df = 1, P > 0.05). When lumped together, the two subsets showed a very high proportion of birds with at least one new remex (85%; Table 3).

DISCUSSION

The presence of new flight feathers in the Little Bittern can be explained by a partial moult performed by the birds before their arrival in Europe. Because first year birds perform a partial moult, which may involve the innermost secondaries (Bezzel 1985), the presence of two feather generations might be assumed as a criterion

Table 2. Moult scores of the remiges of Little Bittern skins examined at the Natural History British Museum, Tring, UK. 0 = old feather, 5 = new feather, (0) = very old feather; R = right, L = left. 'R=L' indicates that both wings showed the same moult pattern. * indicates specimens with only one wing in good condition.

				Secondaries															Primaries										
Place of collection	Date	Sex	Wing	13	12	11	10	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9	10	11
Turkey	1918	M	R=L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genova, Italy	1873	M	R=L	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarborough, UK	15/5/1866	F	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
"Purchased at Steven's"*	7/5/1905	F	R	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Madeira	20/4/1890	F	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sudan	29/4/1901	M	R	0	0	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	0	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alessandria, Egypt	15/5/1901	M	L	5	5	5	(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			R	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
River Rukuru, Malawi	13/2/1938	M	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Khartoum, Sudan	18/4/1908	M	R	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	5	5	5	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Khartoum, Sudan	24/5/1910	F	R=L	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montenegro	29/4/1929	M	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyprus*	19/4/1911	M	L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montenegro	12/4/1906	M	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galuvary (?)	5/5/1929	M	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antiokya Lake, Syria	18/5/1933	M	R	5	5	5	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			L	0	0	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portugal	31/5/1919	F	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White Nile	1/5/1900	M	R=L	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyrenaica, Libya	10/5/1952	M	R=L	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Percentage of Little Bitterns with uniform wing, new secondaries, symmetrical and asymmetrical moult in skins checked at the British Museum and live birds mist-netted at Montepulciano Lake during 1997-1999. R = right, L = left.

	Live birds	Skins	All
N	21	18	39
% of birds with uniform wing	24	6	15
% of birds with new secondaries	76	94	85
% of birds with symmetrical moult in the two wings (R=L)	38	73	55
% of birds with asymmetrical moult in the two wings (R≠L)	63	27	45

for identifying first year birds but the extremely high proportion of birds showing the presence of new flight feathers makes this unlikely. In fact the occurrence of first year birds in West Africa in summer (Morel & Roux (1966) suggests that at least some juveniles remain in the African winter quarters during their second summer, probably because they are still sexually immature. A delayed return to the breeding grounds is also known for other species of trans-Saharan migratory herons, such as the Night Heron *Nycticorax nycticorax* (Morel & Roux 1966).

Consequently it is reasonable to suggest that adults might also perform a partial pre-breeding moult, just before their departure for the breeding grounds. Partial pre-breeding moult occurs in many bird species, and especially in those with distinct breeding and non-breeding plumages (Ginn & Melville 1983). The extent of the pre-breeding moult is usually restricted to some head and/or body plumage, but it can also involve tertials, some inner secondaries and rectrices (Ginn & Melville 1983), as happens in many passerines, such as in the family Motacillidae (Svensson 1992).

Herons are well known for their pre-breeding moult involving ornamental filoplumes, which play an important role during the courtship displays. In the Squacco Heron *Ardeola ralloides* the pre-breeding moult also involves some innermost secondaries (del Hoyo *et al* 1992).

In the Least Bittern, the only species of the genus *Ixobrychus* for which moult patterns are known, there is a post-juvenile moult in autumn and a partial first pre-breeding moult in late winter to early spring, while adults undertake a complete post-breeding (July-August) and a partial pre-breeding moult (Palmer 1962, Gibbs *et al* 1992). The partial pre-breeding moult involves body feathers, with the new feathers much glossier than older ones (Weller 1961).

It is reasonable to expect a similar moult pattern between the Least and the Little Bittern, because, according to some authors, the two species should be included in a single superspecies together with the Yellow Bittern *Ixobrychus sinensis* (del Hoyo *et al* 1992). The renewal of some inner secondaries during the partial prenuptial moult has not previously been described for the Least Bittern (Palmer 1962, Gibbs *et al* 1992), but inclusions of the inner secondaries in the pre-breeding (prenuptial) moult is not surprising. As the new feathers are glossier than the old ones, it is likely that, as in other herons, the function of the prenuptial moult in the Little Bittern might be the renewal of those parts of the plumage that play a role in courtship and mate selection, rather than having an effect on flight performance.

Taking into account these observations, ageing criteria in spring should only rely on the remains of the juvenile plumage, such as retained scapulars and/or wing coverts (great, primary or lesser). The presence of two generations of flight feathers would not be sufficient to age a bird as a first year.

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REFERENCES

Baker, K. (1993) *Identification guide to European Non-passerines*. BTO guide 24. BTO, Thetford.

Bauer, K.M. & Glutz von Boltzheim, U.N. (eds) (1966) *Handbuch der Vögel Mitteleuropas*. Band 1. Akadmische Verlagsgesellschaft, Frankfurt am Main.

Bezzel, E. (1985) *Kompendium der Vögel Mitteleuropas*. AULA-Verlag, Wiesbaden.

Cramp, S. & Simmons, K.E.L. (eds) (1977) *The Birds of the Western Palaearctic*. Vol I. Oxford University Press, Oxford.

del Hoyo, J., Elliott, A. & Sargatal, J. (eds) (1992) *Handbook of the birds of the world*. Vol 1. Ostrich to Ducks. Lynx Edicions, Barcelona.

Gibbs, J.P., Reid, F.A. & Melvin, S.M. (1992) Least Bittern. In *The Birds of North America*, (eds Poole, A., Stettenheim, P. & Gill, F.) No 17. The Academy of Natural Sciences, Philadelphia; The American Ornithologists' Union, Washington, DC.

Ginn, H.B. & Melville, D.S. (1983) *Moult in Birds*. BTO Guide 19. BTO, Tring.

Morel, G. & Roux, F. (1966) Les Migrateurs Paleartiques au Senegal, I, Non Passeraux. *Terre e Vie* **113**, 19-28.

Palmer, R.S. (1962) *Handbook of North American Birds*. Vol 1. Loons through Flamingos. Yale University Press, New Haven.

Stresemann, E. & Stresemann, V. (1966) Die Mauser der Vogel. *Journal für Ornithologie* **107**, Sonderheft.

Svensson, L. (1992) *Identification guide to European passerines*. 4th edn. Svensson, Stockholm.

von Lucanus, F. (1914) Zur Biologie der Zwergrohrdommel (*Ardetta minuta*). *Journal für Ornithologie* **62**, 49-56.

Weller, M.W. (1961) Breeding biology of the Least Bittern. *Wilson Bulletin* **73**, 11-35.

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