

twang	thumping	undulating	whistle	wierd
throaty	thudding	utterance	whisper	warblery
tinny	thundering	un-musical	warble	
tipping	tattoo	un-ringing	woodeny	xylophone-like
tipper	tantara	un-resonant	wet	
tsipper	tolling	uncanny	wiry	yowl
tseep	tintinnabulation		watery	yawn
thin	treble	voice-like	wrenching	yap
tenuous	tenor	vocal	whinny	yip
tick	tune	vibratory	whimper	yell
thick	thrum	voluble	whizz	yodle
troll	tymbal	ventriloquial	whir	yawp
tight	throb	vociferation	whoop	yelp
trumpet-like	tattle	violent	wrinkle	
twitter	thrushy	velvety	weak	zizzy
tweet	tree-cricket-like		whipping	zip
trickling	talk	whine	whirling	zing
tang		wail	whetting	
tink	ululation	wheeze	wind-bell-like	

Palo Alto, California, June 16, 1923.

A STUDY OF SOME PLUMAGES OF THE BLACK TERN

(WITH TWO PHOTOS)

By A. J. VAN ROSSEM

AMONG the specimens collected for Donald R. Dickey by the writer during the summers of 1920 and 1921, at Buena Vista Lake, Kern County, California, was a small series of Black Tern (*Chlidonias nigra surinamensis*). These were obtained on various dates ranging from May to September, and were taken more or less in the way of routine collecting, with the object of outlining roughly the post-nuptial molt,—the change from dark summer to light winter dress. When this series was assembled it became evident that there were many misfits,—in other words, plumages which refused to accommodate themselves to an orderly sequence. In 1922 and 1923, therefore, a special effort was made to work out some of the problems for which the small series previously collected offered no solution. In addition to this personally taken material, use has been made of specimens in the Museum of Vertebrate Zoology. My thanks are due also to Dr. L. B. Bishop, for many helpful hints and suggestions.

The nesting and downy young of this species are so well known that any space devoted to them would be a rather useless repetition of other accounts. However, one item about egg laying may well be emphasized because it has an indirect bearing on the subject which this paper is intended to cover, namely certain phases of plumages and molts. The writer is confessedly ignorant of what has been done in recent years in the study of molt-causation, but, as the following observation has been of interest to others to whom it has been men-

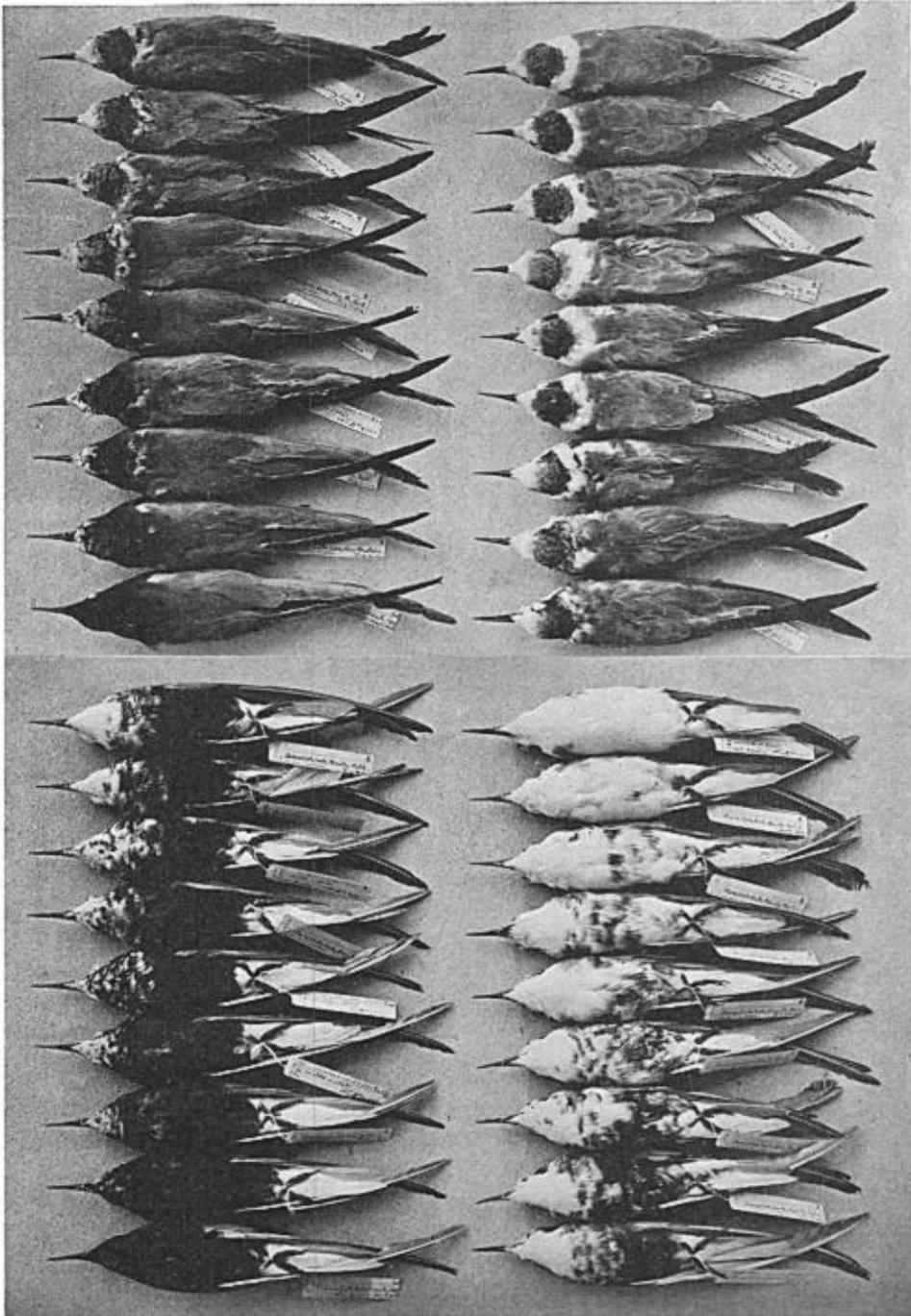


Fig. 59. THE FALL MOLT OF THE ADULT BLACK TERN; ARRANGED FROM BOTTOM TO TOP, IN TWO ROWS, VENTRALLY AND DORSALLY.

tioned, it is hereby offered as of possible value. It is almost axiomatic that breeding and molting follow a more or less regular sequence; that molting in the natural course of events follows breeding, and an inter-relation between the two is naturally to be inferred. Therefore, it was rather surprising to see these Black Terns, whose nests were destroyed again and again by wind storms, continue to lay until they were in some cases halfway through the "post-breeding" molt. In this instance, then, at least, we have a case in which

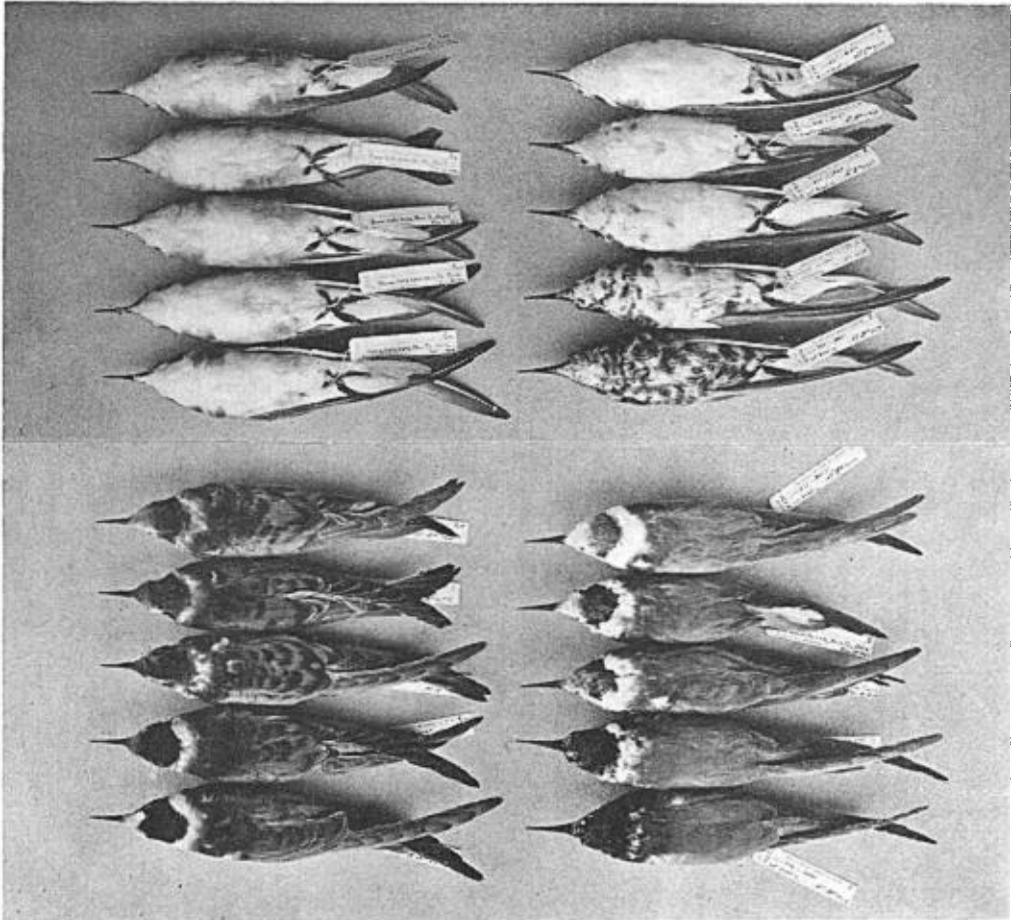


Fig. 60. Left-hand row: SELECTED JUVENILES SHOWING CHANGE THROUGH WEAR; YOUNGEST AT TOP, OLDEST AT BOTTOM. Right hand row. SELECTED VARIATIONS OF FIRST SPRING PLUMAGE.

molting and laying were occurring at the same time, with neither function suppressing the other.

Juvenal and First Winter Plumage.—The completely feathered juvenile, from which the last trace of down has been shed, in general resembles the winter adult, from which it differs as follows: darker throughout, with a brownish wash over the whole plumage (most pronounced on the dorsal surface and least noticeable on the central underparts); flanks and sides more

extensively grayish; remiges and rectrices with narrow edgings of pale gray on tips and along inner edges. These edges soon disappear and the brown fades and is abraded from the contour plumage. The forehead, underparts, and hind neck become almost as white as are those parts in the adults. The crown becomes blacker—sometimes sooty black—and therefore much darker than in old birds where the black is confined to the auricular and preocular regions. The back, wings, and tail remain very dark, and on the first named section a good deal of brown tipping remains. The only new feathers which are acquired before the last birds' leave, the first week in October, are a few white ones on the underparts. Careful examination of specimens at the time of preparation showed this to be the only change which takes place in the juvenal plumage between July 1 and October 1, with the exception of the abrasion and fade noted above.

First Spring Plumage.—This is a highly variable stage and is the intermediate step toward the adult plumage. Some individuals are superficially much like winter adults, and from this light extreme they range to a mixed black and white plumage in which the black is predominant, and the mantle color closely approaches the shade seen in summer adults. The piebald type bears a rather close resemblance to some stages of the molting summer adult, but from an entirely different cause in that the variegated molting adult has black feathers mixed with white feathers, while the younger bird is white, with a variable amount of black tipping. It is this variability in the matter of black tipping that causes the wide range of marking in birds of this age. There is seemingly no trace of any wholly black feathers, although there are a great many pure white ones. This plumage is the first change from the juvenal stage of the previous late fall. It results from a renewal of the entire juvenal plumage, including tail and flight feathers, except for some of the wing coverts and some scattered body feathers. Probably the body molt takes place on the average a little earlier than the spring molt of the adult, for some wear is noticeable by June 1, while adults at this date are still in comparatively fresh and unabraded plumage. Occasional one-year-old examples taken as late as the first week in June retain one or two old juvenal primaries, but this is not extraordinary, considering that at this age they go through a complete wing molt, whereas the adults almost never renew all of the primaries, and never all of the secondaries at this season. The last juvenal (outermost) primary is shed near the first of June, and almost immediately the change into the second winter plumage begins.

Representatives of this age (first spring) are very much in the minority. The proportion to adults is not more than about one to fifty, and one is immediately tempted to conclude that a great many individuals attain the black plumage in the first year. Were it not for the fact that careful search fails to reveal a single black bird whose unreplaced secondaries and primaries are other than those of second or third winter plumage, or one which shows even a single juvenal feather, I should be apt to think this possible. In other words, such flight feathers of the previous fall as remain in black birds emphatically are not juvenal feathers; therefore all black birds examined were at least two years old. The strong probability is that the majority of one-year-olds do not come north in the spring, but remain in winter quarters until the birds reach maturity, at two years of age. It may be remarked that in all of the one-year-

olds taken, there was noticeable a slight enlargement of the sexual organs, and in two cases—one white and one piebald—they were breeding. Such conditions are present probably in only the most vigorous birds, and—slight as they usually are—act as a sufficient urge to send them on the northward spring journey, whether (rarely) or not (usually) they actually breed upon arrival. In this connection, it may be stated that young birds do not arrive until about June 1, six weeks after the adults.

Second Winter Plumage.—Now takes place a renewal of every feather on the body—the first complete change since the step from downy to juvenal, for some of the wing coverts and a few contour feathers have remained over from the juvenal stage. For the second time (sometimes starting before the last juvenal primary has been shed) all of the primaries are replaced. This plumage is identical with that of the winter adult; the change begins about a month earlier, however, and the new plumage is taken on a little more slowly, for it is completed at the same time as is that of the adult. The primary molt starts simultaneously with the body molt, even before the last juvenal primary has been replaced, about June 1; whereas in adults the primary molt does not start until the body molt is well under way.

Second Spring or First True Pre-nuptial Plumage.—This change results in the well-known black plumage from which the species gets its name, and in which it is most commonly known. It is a complete renewal of the entire body plumage, the tail, sometimes as many as 5 (usually 2 or 3) of the outer secondaries, and very rarely all of the primaries,—usually the inner 4, 5, or 6. It is evidently completed just previous to the northward migration, for up until the last of May, one occasionally finds a few old white feathers on the lower breast and upper belly which still remain unshed. On the other hand, I have seen a fully plumaged black specimen taken as early as April 12. The manner in which the black body is attained is unknown to me, for the birds do not arrive until it is complete or practically so. As with all plumages of this tern, the summer dress is a rather temporary one, and in its complete state is worn for an average of little more than two months. In fact, it might be said that more than half of the Black Tern's life is spent in molting. About July 1, there appear many birds which have 'pepper and salt' faces, the first outward evidence that they are commencing the fall molt.

Adult Fall Molt.—This molt occurs by no means simultaneously in all individuals. Birds with speckled faces are to be found as early as the middle of June, and again a very few retain the full black plumage until the first of August. The dates given here are believed to be average for the mass, and they will serve for most of the birds encountered in California.

Beginning on the loreal region, forehead, and chin (about July 1), the entire head, neck, and upper breast are molted comparatively rapidly and these parts are with the exception of occasional feathers pretty well whitened by the middle of the month. Then there is a lull of somewhere near ten days, during which time most of the few remaining black feathers about the fore parts are shed. It is during this slowing up in the shedding of the body plumage that the primary molt begins, and it is not unreasonable to suppose that the check is due to diversion of a part of the feather-building fluids to the wings. On resumption of the body molt the last week in July, the upper and under tail coverts are shed, the tail molt begins, the white starts to creep down the breast,

and the pale gray of the mantle commences to appear on the back. Thus at this stage, the molt is progressing slowly backwards from the upper breast and hind neck, and rather more rapidly forward from the tail coverts. This is a slow process, and it is not until the first week, or even the middle, of September that the black feathers disappear from the area of the lower breast on the underparts and from the center of the back on the upperparts. About two and one-half months are therefore required for the completion of the body molt,—an extraordinarily long time, judged by ordinary standards.

The Fall Wing Molt.—The carpal joint is the center from which the wing molt commences. It begins in adults about July 15, with the dropping of the first (inner) primary, or at the time when the head and neck molt is practically complete. In the one-year-olds, it commences earlier—about June 1 to 10—as soon as, or even before, the last juvenile primary has been replaced. The primaries are dropped in regular order, each as its inner neighbor reaches full growth. The molt of all the primaries requires somewhere near three months, for when the last birds leave, about October 1, they depart with between two (usually) and four (rarely) primaries still unshed. There is a very close relation between the primaries and their coverts, for each covert is dropped and the new one grown in company with its own primary, and not before.

The secondary molt starts at the carpal joint when the second or third primary is fully grown, and progresses inward. The change is fairly rapid, for the secondaries are finished by October 1. As with the primaries, each succeeding quill is shed when its neighbor has reached full growth. There is no close relation between the secondaries and their coverts. The secondary coverts are shed all at once, at the dropping of the third or fourth secondary. The rest of the coverts and the contour feathers of the wings, are acquired gradually with the body plumage. The direction is from the larger coverts toward the bend of the wing, the lesser coverts being the last replaced, toward the finish of the body molt. The scapulars and tertials are shed comparatively early, and in conjunction with the adjacent body plumage.

Fall Tail Molt.—This molt begins between the dropping of the third and fifth primaries, or just after the secondary molt is under way. There is no iron-clad sequence such as holds with the wing feathers, and no very definite rule can be laid down. Numbering the pairs from the inside, the center pair number one, and the outer pair number six, either the first or the second pair is shed first, following these the third, but occasionally the sixth, is dropped (in either case the other pair soon follows): after these come the fourth, and invariably the fifth or next to outer pair is the last to be shed. The duration of the tail molt is comparatively short. The feathers grow rapidly, and even though they must usually (not always) reach full length before the succeeding pair drops, the entire molt does not consume more than five or six weeks.

While the average adult tail possesses a deeper fork and narrower feathers than that of the juvenile or one-year-old, there is so much individual variation in this respect, regardless of age, sex, or season, that to attempt an age diagnosis on such characters would not be possible in all cases.

Summary.—Two years are necessary to attain the black plumage of maturity and during that time the individual passes through four preliminary plumages. These are

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|--------------------|-------------------|
| (1) Natal or Downy | (3) First Spring |
| (2) Juvenal | (4) Second Winter |
| (5) Second Spring | |

Pasadena, California, June 2, 1923.