THE CONDOR

A BI-MONTHLY MAGAZINE OF
WESTERN ORNITHOLOGY

Published by the
COOPER ORNITHOLOGICAL CLUB

VOLUME XXIX | JANUARY-FEBRUARY, 1927 | NUMBER 1

THE SURF-BIRD'S SECRET

WITH NINE ILLUSTRATIONS

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(Contribution from the Museum of Vertebrate Zoology of the University of California[1])

IN SPITE of the facts that the bird has been known to science for almost a century and a half and that many specimens have been collected, the Surf-bird (*Aphriza virgata*) has for many decades held the distinction of being the outstanding species among the very few North American birds whose nest and eggs have remained unknown. Because they have remained undiscovered for so many years, the eggs and nest of this bird have come to be specially sought for by ornithologists.

The Surf-bird was described by Gmelin in 1789 under the name *Tringa virgata*. The original bird came from the region now known as Prince William Sound, Alaska. *Aphriza* is now known to be a shore-bird characteristic of the Pacific coast of the Americas. It winters in South America as far south as the Straits of Magellan, and it breeds in central Alaska. Twice each year, in migration, it traverses the Pacific coast of both North and South America.

The writer has been unable to find any record of "young of the year" having been collected previous to 1856. In his Catalogue of Aquatic Birds exhibited by the United States National Museum at the Great International Fisheries Exhibition held in London in 1883, Robert Ridgway lists a juvenal specimen, no. 24256, of the Surf-bird taken at San Francisco, California, September 11, 1856, by J. Hepburn. (See Ridgway, 1883, p. 146.)

Dr. E. W. Nelson, Chief of the Bureau of Biological Survey, was one of the first ornithologists to gain any information as to the breeding of the Surf-bird. In his well-known report on the natural history of Alaska (1887, p. 128) he records "a young male taken at St. Michaels, August 19, 1879." From his detailed description it is clear that his specimen was a bird-of-the-year. During his four years (1877-1881) of exploration in Alaska, Dr. Nelson failed to find any Surf-birds during the nesting season. He states (*loc. cit.*): "The natives, however, claim that it is found breeding on the bare mountains in the interior." He must have been somewhat skeptical because he added "but they probably mistook it for some other bird." Dr. Nelson's specimen eventually reached the British Museum, through the Henshaw collection.

While on his initial trip to Alaska, Dr. Joseph Grinnell collected five adult Surf-birds at Sitka, on July 21, 1896. There was no proof that these five birds, three males and two females, had nested recently; but their capture gave weight to the theory that the breeding ground must be not very far to the northward of this point. On a

[1] Field expenses of this expedition were generously provided by Mr. John E. Thayer who also supplied the funds which enables THE CONDOR to print the colored plate accompanying this article. Mr. George M. Wright supplemented Mr. Thayer's contributions by granting free use of field notes and of the painting of the Surf-bird and its eggs, by Major Allan Brooks.

subsequent trip, to the Kotzebue Sound region of Alaska, Dr. Grinnell collected three adult Surf-birds on the Kowak River, on May 29, 1899. Two of these birds were "males with testes one-fourth inch in diameter." "The largest ovum in the female was one-eighth of an inch in diameter." An Indian of the neighborhood recognized the birds when they were shown to him and said that they nested "in mosquito time" about the small lakes far back on the tundra in the Selawik Range on the south side of the Kowak Valley. (See Grinnell, 1900, p. 29.) This evidence fixed the approximate time when the Surf-birds nest; and furthermore, it is doubtless the basis for the statements subsequently made that the breeding ground is "probably in the interior of northwestern Alaska."

During the past seventeen years the present writer has been a member of five expeditions to Alaska. During each of these trips, the unknown nest and eggs of the Surf-bird were kept in mind; but continued search produced only negative results so far as Surf-bird nests were concerned. Before and during this period many other naturalists, including A. M. Bailey, Bishop, Brandt, Brooks, Conover, Hendee, Mur-

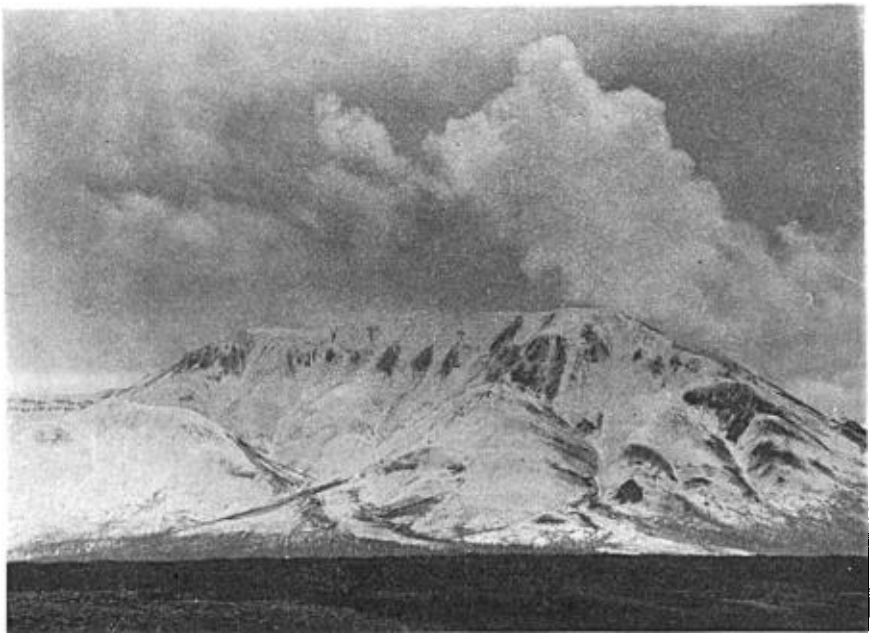

Fig. 1. A TYPICAL SUMMER HABITAT OF THE SURF-BIRD IN THE MOUNT McKINLEY DISTRICT, ALASKA; JUNE 6, 1926.

dock, Osgood, Swarth, and Walker, carried on field work in Alaska. While these men obtained little positive data regarding the nesting ground of the Surf-bird, the work of each has been important because it eliminated more and more of the possible territory where Surf-birds might have been expected to breed.

More recently, Mr. O. J. Murie, of the Biological Survey, while investigating caribou on the headwaters of the Forty-mile River on the divide between the Yukon and Tanana rivers, found, on July 13, 1921, a young Surf-bird, "probably from five to seven days old". This young bird was with its parents, one of which, the male, was collected. Mr. Murie again found Surf-birds high in the Alaska Range at the head of the Savage River, on July 4, 1923, recording that "a flock of twelve, evidently

non-breeders, were feeding on a high slope" (Murie, 1924, p. 236). Mr. Murie expressed the opinion (p. 237) that "The birds seen in the high Alaska Range were not nesting, but their presence there may be suggestive . . . and it is probable that later observations will prove the Surf-bird to be a summer resident of that section."

On May 27, 1924, Major Allan Brooks shot an adult Surf-bird at Carcross, Yukon Territory (Swarth, 1924, p. 73).

This was the Surf-bird situation in 1925 when the writer again became active in the quest. Profiting by his own previous experience as well as that of other naturalists who have worked in Alaska, he came to the conclusion that it was useless to look for eggs of the Surf-bird near the coast or even at low altitude. By a process of elimina-

FIG. 2. SURF-BIRDS WERE FOUND MOST FREQUENTLY AT THE FOOT OF SOME RUGGED CLIFF WHERE THE WHITE ALASKA SHEEP DWELL.

tion the search was narrowed down to the higher mountains of interior Alaska. A trip to the headwaters of the Forty-mile River was planned, but was abandoned because of illness and of the difficulty of transportation.

On May 3, 1926, through joint support and sponsorship of the University of California and Mr. John E. Thayer, the writer with Mr. George M. Wright as companion, started out on a three months' study of the birds and mammals of the Mount McKinley district of central Alaska. And at the same time we again took up the long, long trail of the Surf-bird. Upon our arrival at Mount McKinley Park on May 19 we were kindly received by Park Superintendent Karstens and members of his staff. To his helpful suggestions and assistance is due in large measure our ultimate success.

The south side of the Alaskan Range is in this region characterized by a heavy snow fall, while on the northern or interior slope the snow fall is relatively light. The

winter preceding our visit had been exceptionally mild, and we found the summer season at least two weeks ahead of normal when we arrived. It should be explained that nearly all of the Park in which we worked is above timberline, and this on the north slope of the Alaskan Range rarely extends above 3000 feet. Some adequate conception of the zonal complexion of the region may be had from the fact that Mount McKinley extends 17,000 feet above timberline. By May 20, the snow had melted on the open plains and lower ridges, but along the river bars where the snow had drifted, snowbanks four feet deep still existed. At this time the willows had not yet begun to leaf out. A thorough search along the rocky river bars revealed a pair of Wandering Tattlers evidently preparing to nest; but no trace of Surf-birds could be found, so we directed our search to higher ground.

At this season the foothills were subjected to spring snow storms which powdered them with white clear down to timberline (see fig. 1).

The Surf-bird's scientific name is derived from the Greek *aphros,* sea-foam, *zao,* I live. The common name also indicates the habit these birds have of feeding on outlying reefs and rocks of the sea-shore, unmindful of the flying salt spray which sometimes breaks completely over them. During the fall, winter and spring the Surf-bird has been observed feeding upon barnacles and other small marine animals that it finds on the surf-washed rocks and reefs of the Pacific Ocean. During the major portion of the year the Surf-bird is thus a strictly littoral species, being rarely or never found away from the coast. This fact doubtless led to the belief that the nesting grounds of this species would also be located somewhere on the coast in the far north.

However, this has not proved to be the case. One of the most striking things about the Surf-bird is the remarkable difference between its winter and summer habitat. Near the end of their northward migration in the spring these birds abandon the sea coast and take up their summer residence far in the interior, from 300 to 500 miles from salt water. This involves a great altitudinal shift. Instead of living at sea level as they do at other seasons, during nesting time they are to be found on barren, rocky mountains high up above timber line. During the entire summer we never found these birds below 4000 feet elevation. With this marked change in habitat has come a corresponding great change in food and food habits. In summer, instead of living on sea food, the Surf-bird turns to an insect diet, living then almost entirely upon active insects which it captures by stealth or by fair chase in the open.

The rocky character of the Surf-birds' surroundings appears to remain fairly constant throughout the year. In summer the birds are to be found most frequently near the summits of the rock slides where the broken rocks are much the same as the rugged reefs they inhabit during the winter. We found in the Mount McKinley district that the summer range of the Surf-bird was almost identical with that of the Mountain Sheep and that it was useless to look for Surf-birds outside of "sheep" country.

On June 7 two Surf-birds were found feeding at 4200 feet elevation, among the little rivulets that tumbled over the cliffs directly from the melting snow above. One of these two birds was shot and proved to be a female which at this date had already laid a set of eggs. On June 18, three Surf-birds were seen close under the summit of a mountain. Here they occasionally ran about and picked up insects, but more often they stood still on exposed rocks and preened their feathers. One of these three birds frequently raised both wings, willet-fashion, over its back until they almost met. These individuals were exceedingly shy and would not allow the naturalist to approach closer than 100 yards. We found that this timidity was customary during the nesting season, when the birds were encountered away from the immediate vicinity of the nest.

At 8 o'clock on the evening of June 24, I climbed to the crest of a sharp ridge of one of the lower spurs of the main Alaskan Range. As I reached the highest peak four Surf-birds flew in from a distance. As they circled about the peak they called *tee, tee, teet,* loudly. Their flight was swift and plover-like. As they turned, the white basal portions of their tails, together with the white bars of their wings, formed four white V's which stood out vividly in the strong glow of the evening sun. They circled the peak several times, calling loudly and evidently seeking for others of their kind. Soon there was an answering call from the ground and the four birds settled down on a rocky spur where three other Surf-birds were already feeding. When I crawled up to within fifty yards of them all seven birds ceased feeding and began to call loudly. After a period of several minutes they began to feed again, one remaining on guard while the others ran hither and thither chasing insects over the rocks and

Fig. 3. THE MALE INCUBATED THE EGGS. THE NEST WAS ENTIRELY OUT IN THE OPEN, ON A BARREN ROCKY RIDGE, 1000 FEET ABOVE TIMBER-LINE.

tundra. I watched them feeding for nearly an hour, but it was obvious that this was a feeding and not a nesting ground. At 9:40 o'clock in the evening, just as the last rays of the setting sun vanished from the crest of the ridge, the Surf-birds arose suddenly and flew away to a higher peak where the sun was still shining, and insects were still active.

Three days later, seven Surf-birds were found feeding in company at mid-day near this same spot. This time they were foraging near the top of a very steep talus slope that lay fair to the sun. Only a few scant flowers grew amid the rocks, but insects were numerous and active. One Surf-bird which, when later collected, proved to be a male stood guard while the others fed. The slightest movement on my part was sufficient to cause a warning note to be given by this sentinel. When feeding,

these birds ran hurriedly over the rocks, traveling as fast or faster than a man could walk. When an insect was sighted the pursuing Surf-bird would stretch out its neck as far and as straight as possible. Then moving stealthily forward the bird would make a final thrust and secure the insect in its bill, much in the same manner that a turkey stalks a grasshopper.

Stomachs of Surf-birds collected in the Mount McKinley district were preserved and submitted to the Bureau of Biological Survey for detailed examination. Mr. Charles C. Sperry, of the Division of Food Habits Research, of the Survey, examined the material and reports as follows.

No. 175612 Biol. Surv. (8735 J. D.), female, June 7, 1926: condition of stomach, full; percentage of animal matter, 100; gravel, etc., 20; contents, Carabidae: fragments of 5 *Carabus truncaticollis*, 6 *Cryobius* sp., 6 *Curtonotus brunnipennis*, and 1 unidentified, 30%; 5 *Chrysomela subsulcata*, 24%; 1 *Cytilus sericeus*, 2%; weevils: 3 *Lepidophorus lineaticollis*, 3 *Lepyrus*, and 1 *Dorytomus* sp., 24%; fragments of 1 *Cryptohypnus* sp., trace; remains of craneflies (Tipulidae), larvae, pupae, and adults, 16%; fragments of 3 Hymenopterons, trace; spider fragments, trace; fragments of several young snails (*Littorina*), 4%.

No. 175613 Biol. Surv. (8806 J. D.), male; date, June 20, 1926: condition of stomach, full; percentage of animal matter, 100; gravel, etc., 60; contents, Carabidae: *Platynus cupripennis* and 1 unidentified, 2%; weevils, 3 *Lepidophorus lineaticollis*, and 1 *Lepyrus*, 34%; 2 *Cryptohypnus* sp., 3%; and another beetle (probably Melandryidae), 1%; Lepidoptera: 2 caterpillars and fragments of cocoons, 14%; Hymenoptera, including Ambletelinae and Nematinae, 18%; Diptera: remains of larval and adult craneflies (Tipulidae), 28%.

No. 175614 Biol. Surv. (8840 J. D.), female; date, June 24, 1926: condition of stomach, full; percentage of animal matter, 100; gravel, etc., 60; contents, fragments of *Carabus truncaticollis*, trace; 3 *Lepidophorus lineaticollis* and 2 *Lepyrus*, 60%; Diptera: Remains of Tipulidae and Dolichopodidae, 34%; 2 caterpillars, 2%; Hymenoptera: fragments of Ichneumoninae, 2%; fragments of a Phalangid, 2%.

No. 175615 Biol. Surv. (8841 J. D.), male; date, June 24, 1926: condition of stomach, full; percentage of animal matter, 100; of gravel, etc., 80; contents: Beetle fragments (Carabidae), trace; Craneflies (Tipulidae), pupae, adults, and eggs, 95%; Hymenoptera: including an ant (*Tapinoma* sp.) and a sawfly (*Dolerus* sp.), 5%; fragments of a moth, trace.

No. 175616 Biol. Surv. (8842 J. D.), male; date, June 24, 1926: condition of stomach, full; percentage of animal matter, 100%; of gravel, etc., 50; contents: fragments of *Cryobius* sp., 6%; fragments of *Chrysomela subsulcata*, 1%; 5 *Lepidophorus lineaticollis*, 15%; 1 caterpillar, 1%; 2 bugs (Miridae) and fragments of Hymenoptera (Ichneumoninae), trace. Diptera: Remains of Tipulidae and Dolichopodidae, 75%; fragments of a Phalangid, 2%.

No. 175617 Biol. Surv. (8843 J. D.), male; date, June 24, 1926: condition of stomach, full; percentage of animal matter, 100; of gravel, etc., 70; contents: fragments of *Carabus truncaticollis*, 2%; weevils: 3 *Lepidophorus lineaticollis* and 1 *Lepyrus*, 70%; fragments of *Chrysomela subsulcata*, trace. Hymenoptera fragments, 2%; Craneflies (Tipulidae), 24%; 2 small caterpillars, 2%; fragments of a Phalangid, trace.

No. 175618 Biol. Surv. (8844 J. D.), male; date, June 24, 1926: condition of stomach, full; percentage of animal matter, 98; of vegetable, 2; of gravel, etc., 55; contents: fragments of Carabids (inc. *Cryobius* sp.), 4%; fragments of *Chrysomela subsulcata*, 4%; 1 *Lepidophorus lineaticollis*, 2%; 1 *Byrrhus* sp., 2%; remains of craneflies (Tipulidae), 72%; Lepidoptera: fragments of cocoon and 2 caterpillars, 12%; Hymenoptera: fragments, trace; fragments of a Phalangid, 2%; 2 seeds of *Oxytropis* sp., 2%.

No. 175619 Biol. Surv. (8859 J. D.), male; date, June 27, 1926: condition of stomach, full; percentage of animal matter, 100; of gravel, etc., 30; contents, Carabid fragments (including *Carabus truncaticollis*), trace. Fragments of a weevil (*Lepyrus*) no. 175614, 2%; fragments of 2 Hymenopterons, trace. Remains of many craneflies (Tipulidae), 98%.

SUMMARY OF FOOD OF THE SURF-BIRD DURING THE NESTING PERIOD

Number	Sex	Coleoptera	Hymenoptera	Diptera	Lepidoptera	Phalangidea	Snails	Plant Seeds
175612	♀	80%	.....	16%	.....	.....	4%	.....
175613	♂	40%	18%	28%	14%	.....	.....	.....
175614	♀	60%	2%	34%	2%	2%	.....	.....
175615	♂	.....	5%	95%	.....	.....	.....	.....
175616	♂	22%	.....	75%	1%	2%	.....	.....
175617	♂	72%	2%	24%	2%	.....	.....	.....
175618	♂	12%	.....	72%	12%	2%	.....	2%
175619	♂	2%	.....	98%	.....	.....	.....	.....
Average		36.0%	3.3%	55.2%	3.8%	1.0%	.5%	.2%

By watching, with binoculars, Surf-birds that were feeding it was possible to identify many of the insects that were being captured. The larger insects, such as beetles, were the ones most readily identified and recorded, and the author's observations made in the field check closely with stomach examinations made in the laboratory. From the accompanying table of stomach examinations it will be seen that insects form 98.3% of the Surf-bird's food during the breeding season. Diptera (flies) head the list, forming over one-half (55.2%) of the stomach contents, while Coleoptera (beetles) were second, forming 36% of the Surf-bird's summer diet.

During May the new snow rarely lasted more than a day or two, but along the crest of the ridges at 6000 feet it merely added to the previous winter's snow which still lay waist deep in many places. It seemed highly improbable that even Surf-birds would be found at the extreme crests, but we continued our search upwards until stopped by snowslides that were too steep to cross or by unscalable cliffs. We failed to find any sign of Surf-birds during the first week's search, and since we rarely found Leucostictes above 5000 feet we decided to hunt lower down along the rock slides and talus slopes at bases of cliffs (see fig. 2).

When standing on a barren wind-swept ridge late in the afternoon of May 28, searching a nearby hillside with binoculars, Mr. Wright's attention was attracted to a grayish bird that was sneaking hurriedly along over the rocky ground. As he watched, the bird apparently faded out of sight some six hundred feet away. Marking the point of disappearance he hurried over to the spot where the bird was last seen and, failing to find the bird, began to think he was mistaken. But, upon his taking one more step, the bird flew up suddenly right into his face, startling him mightily. As the bird flew away, the large white rump patch, together with a white patch on either wing, brought realization that this was the long-sought-for Surf-bird. A hasty glance at his feet revealed the nest and contents of four eggs. Another step forward and he would have placed his foot directly in the nest! To George M. Wright belongs the honor of being the first white man, of which we have any record, to lay eyes on the nest and eggs of this rare bird.

The Surf-bird's nest was located 1000 feet above timberline on a rocky ridge that faced southwest and lay fair to the sun and hence was relatively free from snow. The nest site was on dry rocky ground and not on the wet tundra which was plentiful nearby. The rocky ground about the nest was clothed with a thin carpet of alpine-arctic vegetation, the tallest of which were a few creeping arctic willows less than two inches high (see colored frontispiece). The most conspicuous plant about the nest was the white-flowered *Dryas integrifolia*. The nest was entirely out in the open with no bushes to afford the least concealment (see fig. 3). In fact it was almost "out in the street", since the eggs were within a foot of a frequently traveled trail of the white Alaska Mountain Sheep (*Ovis dalli*). There was no fabricated nest such as the Wandering Tattler makes. Instead, the eggs were deposited in a natural erosional depression, the sides of which had been lined with a few bits of dried-up grayish green lichens and caribou moss (see fig. 4). The bottom of the nest was composed of the

dead emarginate leaves of *Dryas integrifolia,* which only partially covered the crumbling serpentine outcrop that formed the backbone of the ridge. The nest, which was barely large enough to hold the four eggs, which were placed as close together as possible, with little ends down, measured four inches in diameter and an inch and a half in depth. The eggs in the nest blended so well with the reddish brown moss of the tundra that it became difficult to make them out at a distance of more than eight or ten feet.

The eggs of the Surf-bird (see fig. 4) are not easily confused with the eggs of any other North American sandpiper or plover. In shape they are pyriform but, though similar in form to eggs of other birds of the order Limicolae, in color they appear more like eggs of the falcons, particularly certain eggs of the Sparrow Hawk and Prairie Falcon.

Fig. 4. THE NEST WITH ITS FOUR EGGS, HERE SHOWN NATURAL SIZE, WAS LOCATED IN A NATURAL EROSIONAL DEPRESSION.

In the type set, which is now safely housed in the well-known Thayer collection, there is considerable variation both in the ground color and in the markings of the eggs. Three eggs of this set have an intensely buffy ground color, while the fourth egg is of the same color but decidedly lighter. The markings on the three eggs are bold, varying in color from Fawn color to Bay. (In this article color terms beginning with capitals are from Ridgway, 1912.) The markings on the fourth egg are small and evenly distributed. The four eggs may be described as follows. The first egg has a light ground color which equals Tilleul-buff. In this egg the marking consists of fine splashes, ½ to 2 millimeters in length. There is but slight tendency for the markings to form a wreath on the larger end. A few small dark brown spots on its

larger end identifies this egg, which resembles slightly certain eggs of the Yellow-billed Magpie. In egg number two the ground color is rich Tilleul-buff, while the markings consist of bold Bay-colored spots and splashes from ½ to 3 millimeters in length. These spots are concentrated about the larger end of the egg, where in places they are so dense as completely to obscure the ground color. A few deep-seated lavender under-shell markings are apparent on this egg. Egg number three is similar both in ground color and in markings to egg number two, except in egg number three the heavy Bay markings form a decided wreath 21 millimeters in diameter about its larger end. Egg number four has the richest ground color of all, while its markings are Fawn, but the markings are not so sharply defined as in the other eggs.

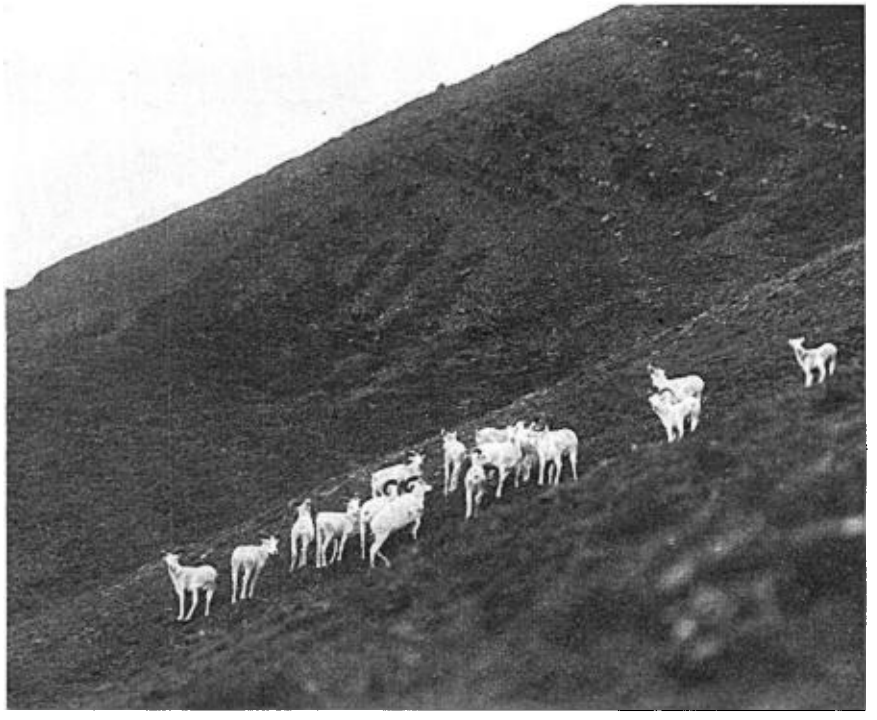

Fig. 5. MOUNTAIN SHEEP GRAZED DAILY OVER AND AROUND THE SURF-BIRD'S NEST.

The four eggs measured, in millimeters, and weighed, in grams, as follows:

MEASUREMENTS AND WEIGHTS OF FOUR SURF-BIRD EGGS

	Length	Breadth	Weight
	43.7	30.5	19.8
	41.5	31.5	20.0
	43.3	31.2	20.1
	42.4	31.0	20.1
Average	42.7	31.0	20.0

All the eggs were fertile with well-developed embryos in each. They had been incubated about one week, I judged. This would indicate that the eggs had been laid about May 20. It was our experience that the Surf-bird nested earlier than any other of the several species of shore-birds that we found breeding in the Mount McKinley district. We found, in the sexual organs of these birds, that breeding evidence had almost disappeared by the last of June, after which date breeding birds might easily have been mistaken for non-breeders.

Desiring to spend as much time as possible at the nest, both to observe the birds and also to protect the nest from being trampled under the hoofs of numerous mountain sheep that foraged daily (see fig. 5), and bedded down nightly, all around the Surf-bird's nest, we took notebooks, binoculars, and still and movie cameras and spent the entire night and half of the next day at the nest. It was almost 9 o'clock in the evening when we arrived at the Surf-bird's nest. Since it was cold and late we did not disturb the incubating bird, but only took a few photographs in the fast fading light.

In order to be able to watch the nest continuously we piled up a crude shelter of rocks on the crest of a ridge overlooking the nest and about 80 feet distant from it. This gave us protection from the biting wind, but the rain which began to fall about 10 o'clock soon turned to snow. When it began to rain, the Surf-bird merely fluffed up and then spread out the feathers on his back so as completely to cover the nest (see fig. 6). This proved an effective method, because the melting snow and the rain

Fig. 6. THE MALE SURF-BIRD ON THE NEST. DURING SNOW STORMS THE BIRD'S FEATHERS WERE SPREAD OUT AS HERE SHOWN, KEEPING THE EGGS WARM AND DRY.

ran readily off the Surf-bird's back and was absorbed by the moss outside the nest. We were not so well protected and were soon shivering and wet to the skin.

From 11 o'clock in the evening until one o'clock the following morning it was too dark to read print or to see to write, but the rest of the "night" was only twilight. Shortly after midnight, when the sky became brighter, the wind lulled, and the snow ceased for the time being; then the clear sprightly song of an Intermediate Sparrow came up to us in the mist from the drenched willow thickets below. At one o'clock in the morning an unseen male Rock Ptarmigan cackled hoarsely, off in the dense clouds that surrounded us.

At four o'clock, a female mountain sheep appeared, silently, like a ghost, out of the mist that came drifting over the mountain peaks in great white swirls. She did not see us at first, but when she was within six feet of, and headed directly toward, the Surf-bird's nest, she became suddenly aware of our presence and took a step or two

forward. When the ewe was about to step on the nest the Surf-bird suddenly "exploded" right in the astonished animal's face. This unexpected movement and the sudden noise and flash of white of the bird's spread wings and tail caused the mountain sheep to jump back quickly; then she whirled around and bounded off back up the trail. This sudden movement of the Surf-bird at the critical moment doubtless serves to prevent sheep and caribou from trampling upon its nest and eggs. We found through repeated experiments that this was the bird's regular reaction. When we approached, whether fast or slow, the bird would stay on the nest until the last minute and then instead of sneaking off low to the ground, like most birds do, would fly directly up into our faces. Even after we knew that the bird would do this, the psychological result on our part was the same. A person would involuntarily recoil when the bird "exploded", like a fire-cracker, right in his face.

We left the Surf-bird's nest covered with a flat rock, after the eggs had been removed, and coming back several days later found that a mountain sheep had come down the hill, knocked the rock off the nest, and stepped into the nest, the hoof prints being exactly where the eggs had been.

The nest was visited by one or the other of us at hourly intervals all through the night, and we always found the Surf-bird faithfully on the job. The only noticeable change was in the bird's shifting a quarter turn around on the nest so as to face the wind.

When first frightened off the nest by Mr. Wright the previous afternoon, the bird, which we later thought might have been the female, after "exploding" ran away with wings half spread and the tail spread out fan-like and dragging on the ground. This displayed conspicuously the white rump patch. Now and then this bird would nestle down as though covering a nest. When about one hundred yards distant from the nest the bird began to wander about, pretending to feed. It exhibited no concern whatever when Mr. Wright returned to the nest and examined the eggs. It made no attempt to return to the nest even after the observer had retired to a distance and waited for a period of ten minutes, during which interval rain began to fall.

In marked contrast with this rather indifferent attitude, the bird which was watched on the nest for sixteen hours, behaved in an entirely different manner. This second bird, when forced off the nest, would fly directly up into the intruder's face, and then run off to one side, a distance of eight or ten feet, where it would perch on a rock (see fig. 7), fluff out its feathers like a "sitting" hen and utter a low plaintive call, *tee-tee-teet!* The call would often be repeated two or three times after a slight pause of half a minute between calls. When we started after this bird it would lead us adroitly away from the nest; but if we stood still it would soon hustle directly back, even when we were standing only ten feet distant. In going on to the nest the bird was very careful not to step directly upon the eggs. It would trot up to within a foot or so of the eggs and then sneak cautiously down to the edge of the nest. Here it would stop, inspect the eggs, and reach out with its bill and turn the eggs about (see fig. 8), keeping them little ends down. Following this inspection the bird fluffed out the feathers on its breast and sitting down gently on the edge of the nest, slid its body forward with great care, until the eggs were completely covered.

When frightened off the nest, this Surf-bird sometimes picked up small grass seeds and insects from bare places in the rocks, but during the sixteen hours that we watched, it never once left the nest voluntarily, and it always returned to the eggs within three or four minutes. The bird seemed to realize that the eggs would chill fatally if left uncovered for any length of time, and doubtless they would have done so, for my fingers after a while became so stiff and cold that I was unable to work the cameras.

Only the one Surf-bird put in an appearance at or near the nest during our entire stay of a day and a half. This bird, which was incubating, was at first presumed to be the female because of its evident anxiety for and care of the eggs. The bird was under close constant observation from early morning until noon, when it was collected just as it left the nest. Imagine our surprise upon preparing the specimen to find that it was not a female at all, but a male bird with well developed testes which were almost half an inch long.

During subsequent observations, when both sexes were present, as was revealed by our taking specimens, we were unable to find any clew of plumage, size, voice or behavior whereby we could distinguish in the field male Surf-birds from females of the species. However, with specimens in the hand during the breeding season we found that five males collected all had bare incubation patches or egg pockets on their

Fig. 7. THE "MATERNAL" MALE SURF-BIRD COMPLAINING BECAUSE HE HAD BEEN DRIVEN OFF HIS NEST.

lower breasts, while none of the females shot had these. At this season, June, the males were thin, supposedly from sitting on the nest. The average weight of five breeding males was thus 126.2 grams. Contrasted with this, two females collected had no incubation patches and both were fat, weighing 150 and 151.1 grams, respectively. From close observation, checked up by careful sexing of specimens collected, it is my belief that in the Surf-bird the male does most, perhaps all, of the incubation. Since we found breeding males feeding together in small companies of three and four, away from their nests, it is still possible that the female remains on the nest, while the male is off feeding and vice versa. It should be noted that I took opportunity to observe and to check up on this point in other shore-birds of the region, particularly in the case of the Wandering Tattler and the Semipalmated Plover. I found that in both these species the males did a large part of the incubation and that it was the males and not the females that were most fearless in the face of danger when caring for their young.

After several seasons experience with breeding shore-birds in the north, the writer has come to believe that in more of our Limicolae than is generally known, it is a common practice for the males to take a leading part in domestic duties not only in incubation but also in the care and training of the downy young. (See Dixon, 1918, p. 398.)

One interesting feature, that of the rapid fading of the nuptial plumage of the Surf-bird, has received scant attention. There is now sufficient material in the Museum of Vertebrate Zoology to show clearly when and how the rufous tone of the back is acquired and how and when it is lost. On March 31, 1926, Mr. Chester C. Lamb of the Museum staff collected ten Surf-birds, eight males and two females, at San Felipe near the mouth of the Colorado River, in the Gulf of California. Of these ten birds all but two had acquired, by molt, more or less of the rufous nuptial feathers on the scapulars. Some birds apparently do not acquire this plumage until the last of April, since a female, M. V. Z. no. 9874, collected April 29, 1909, by H. S. Swarth on Kuiu Island, southern Alaska, showed no rufous at all on the back. On the other

Fig. 8. MALE SURF-BIRD INSPECTING EGGS AND "TURNING" THEM WITH HIS BILL BEFORE SETTLING DOWN ON THE NEST.

hand another female, M. V. Z. no. 9875, taken May 3 at the same locality, is in full breeding plumage. In this latter specimen the scapulars and one tertial are broadly banded near the tip with rich Cinnamon-rufous. The feathers on the top of the head and neck are also margined with Cinnamon-rufous, giving a brownish tone to these regions. (See colored frontispiece.)

In breeding birds we found that in a certain specimen (no. 8735 J. D.) the scapulars had faded to Cinnamon-buff, while in another collected the last of June (no. 8844 J. D.) the rufous markings of the scapulars had faded to white. In many instances the light-colored ends of the feathers have actually worn away leaving a more resistant black tip exposed. In this way the top of the head and neck also become

clearer gray, mixed black and white. Fading and resultant wear in the Surf-bird is similar to that which takes place in the male Snowflake in the spring, when the buffy tips of the feathers fade and wear off, leaving the back black.

During the period between May 19 and July 30, which was spent in the Mount McKinley district, we walked approximately 500 miles, much of the country traversed being high up on the mountain slopes in good Surf-bird country. During this entire time we kept particular watch, but in spite of this attention we encountered Surf-birds only seven times during 72 days spent in the field. Many days were spent searching for Surf-birds in good territory without either of us finding a single bird of this species. Rarely were more than one or two Surf-birds encountered in any one day. The largest flock found consisted of seven adults.

After the first Surf-bird nest was discovered we thought it would be possible to find others, since we would know better just where to look for them. This did not prove to be the case, for continued search failed to reveal any other nest. Later in the season, when downy young of the Wandering Tattler were out, we made special effort to locate downy young of the Surf-bird. Although we searched again over the territory where we had found Surf-birds present earlier in the season, we did not succeed in finding any downy young of the Surf-bird.

There are many hundred square miles of territory along the northern or interior slope of the main Alaskan Range in the Mount McKinley district which are suitable for Surf-birds during the breeding season. It seems probable, from our experience, that there are isolated pairs of nesting Surf-birds scattered at distant intervals over this territory. The small flocks of from three to seven adults that were found during the breeding season are believed to represent individuals which had banded together, temporarily, at feeding time in order to enjoy the benefits of mutual protection from natural enemies such as red foxes and gyrfalcons.

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Berkeley, California, October 25, 1926.