have done under similar conditions, become a pest, not only taking the place properly belonging to more useful birds, but will, at seed-time and harvest, descend upon orchard and field in devouring myriads.

(9) If careful examination and field observation during the next year or so confirm these prognostications, the Chinese Starling should be actively and effectively dealt with ere it is too late, that is, before countless numbers and a wide range render effective action impossible.

(10) The possible extermination of this species on the Pacific Coast would be greatly assisted by the fact that it has markings (peculiar crest, wing-spots, etc.) that readily distinguish it from any native birds.

Berkeley, California, March 31, 1924.

BANDING WHITE PELICANS

(WITH MAP)

By HENRY B. WARD

(Contributions from the Zoological Laboratory of the University of Illinois, No. 238)

CONCERNING one of the most interesting and peculiar North American birds, the White Pelican *(Pelecanus erythrorhynchos)*, relatively little is definitely known of the routes taken by individual groups in migrating from the breeding grounds to the winter feeding grounds. In winter it occurs abundantly along the western shore of the Gulf, both in the United States and in Mexico, along the Pacific Coast of Mexico and part of Southern California, and infrequently in the interior of Mexico.

The breeding grounds are nearly all north of the fortieth parallel and all of them west of the Great Lakes. Due to the encroachments of man many of the smaller breeding places listed by A. C. Bent (Bull. 121, U. S. Nat. Mus., 1922) have been broken up and the large colonies remaining are in Canada or the northwestern United States. Only two breeding grounds are concerned in this paper, one on Yellowstone Lake, Wyoming, the other at or near Reed Lake, in the vicinity of Morse, south-central Saskatchewan, from which a single record will be given first.

On September 30, 1921, a tame pelican, then about six months old, was banded at Morse, Saskatchewan. Although allowed entire freedom it remained at the place of banding until October 22, when it was observed to fly south. Five days later (October 27) it was reported from Lindsay, South Dakota, where its tameness made its capture a simple matter. In reporting the "return" Mr. Ray Norman stated that he had added his own name and address to the band and again released the bird. It has not been heard from since. Reference to the map will show that this bird (no. 100,553) was apparently following the general course of the Missouri River, as Lindsay, although on the Cheyenne River, is but a few miles west of the larger stream. These data are admittedly of a fragmentary nature but they point to the use of a definite and well-known migrational highway for the white pelicans noted in the fall on the streams and lakes of the great plains; these birds come probably from the breeding grounds of the north-central United States and south-central Canada.

In connection with some studies on the pelican at Yellowstone Lake, made under the joint auspices of the United States Bureau of Fisheries and the National Park Service, I had an opportunity to band some of the young birds in July, 1922. I am greatly indebted both to the United States Commissioner of Fisheries and the Superintendent of Yellowstone Park as well as to many others connected with both services for assistance without which my work could not have been carried out.

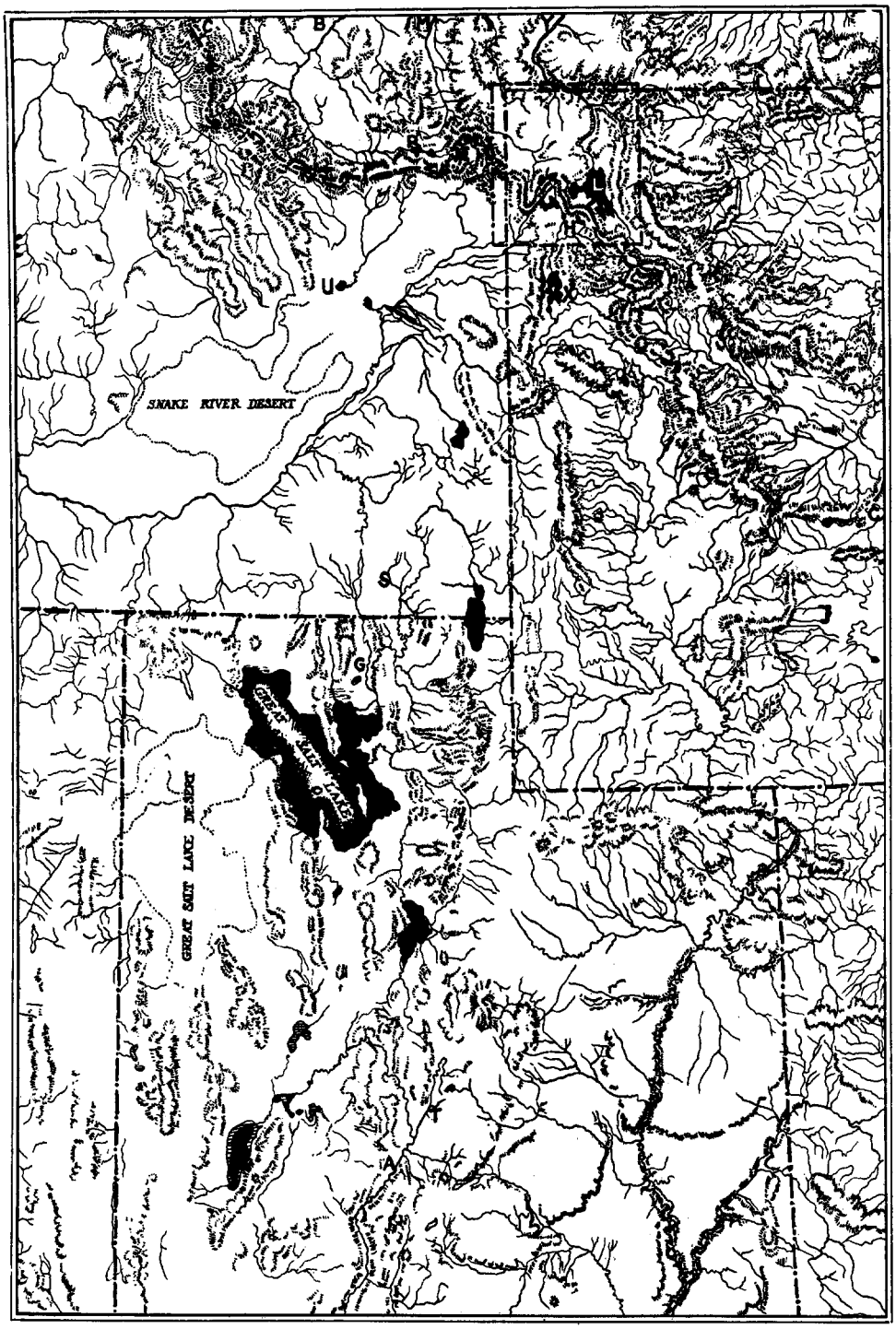

Fig. 42. MAP OF PARTS OF WYOMING, IDAHO, MONTANA AND UTAH, SHOWING MIGRATION ROUTES OF PELICAN AS INDICATED BY RECORDS OF BANDS RETURNED. ONLY THE PROMINENT MOUNTAIN RANGES AND RIVERS OR LAKES ARE INDICATED. LETTERS REFER TO THE FOLLOWING POINTS:

A, Aurora on Sevier River, Utah; B, Beaverhead, Jefferson River, Montana; C-C, Continental Divide; G, Garland on Bear River, Utah; H, Heart, Lewis and Shoshone Lakes; L, Yellowstone Lake; M, Madison River, Montana; R, Red Rock Lake, southwest Montana; S, Swan Lake, Bannock County, Idaho; T, Sterling near Sevier River, on San Pitch River, Utah; U, Mud Lake, Jefferson County, Idaho; Y, Yellowstone River, Montana; X, Jackson's Lake, northwest Wyoming.

We visited several times the low island on which the birds breed and made notes on the habits and growth of the young which were hatched about June 25 to 30. On July 26 the young were already pretty well grown; even a week earlier when we visited the island we found that the old birds had all gone for the day, leaving only the young in the nests. When we neared the shore, some 40 out of the 225 were already in the water and others took to it as we approached the group. The young birds were still covered with down and were not vigorous swimmers, although they rested easily on the water and made fair progress even though it was for a few strokes only. On all subsequent visits they rushed to the water immediately on our approach and it was necessary to head off the groups in order to prevent them from escaping us.

On July 26 we herded them into a large net and put metal bands on the feet of 75 of the largest and strongest. The young birds on the island at this date numbered approximately 200; black wing feathers were just beginning to be evident. On land the young were exceedingly active; they stood erect firmly and ran rapidly; when cornered they began to fight aggressively, striking boldly at their visitors and evidently trying to reach our faces in their thrusts. These actions were in rather marked contrast with those manifested on earlier visits.

The birds that had been banded were carefully inspected on subsequent visits and particular search made for any that might have died between times. Among the small birds found dead on the island later than the date of banding there were only four that carried bands, so that approximately 70 birds must have left the island in the fall flight carrying the bands with them. These bands were of the type furnished by the U. S. Biological Survey. All in all, there have been returned to us, through the Biological Survey, records of seven of the birds that were banded. One of them was reported from a point almost directly west of Yellowstone Lake, no. 201,820, having been found dead at Red Rock Lake, Montana, late in September (exact date not given). No. 201,850 was found at Mud Lake, 40 miles northwest of Idaho Falls, Idaho, on October 1, and no. 201,815 came from Swan Lake, Idaho, on October 23.

One bird, no. 201,835, was taken at Bear River near Garland, Utah, about October 5, one, no. 201,860, at Sterling, Utah, October 11, and a third, no. 201,873, on the Sevier River near Aurora, Utah, about October 10. These all seem to have been members of a group moving almost directly south from Red Rock Lake through the great central valley of Utah and were headed apparently towards the Gulf of California or the coast of Lower Californa, although it is possible that all or part may have later turned southeast towards the Gulf of Mexico.

From the Lake Ranger Service I obtained definite information that the birds had begun to leave the Lake by September 10, and the last had gone by September 25. The breeding grounds on Molly's Island were divided very distinctly between different groups of birds which had arrived at different times and had young of different ages. In one group of 30 nests all the eggs had hatched before our first visit (June 26) though the young were apparently only a few days old. In another group only a small part of the eggs were laid at that date and a third group of nests contained eggs well advanced in incubation. While these groups of nests were continuous in places, like tangential circles or ovals, yet one could readily separate them at a glance. Now one might naturally infer that they represented separate flocks of birds that, arriving at different times, had come from different places or had followed different routes. And yet an examination of the records furnished by the bands returned gives little support to such a view. A brief description of the localities and the region will show some interesting features concerning the migration route.

Yellowstone Lake lies east of the Continental Divide and all the records of the pelicans banded there show that, possibly excepting the first one reported, the birds had crossed that range into the basin west of it. One might perhaps expect them to turn south without crossing the Divide and yet the actual conditions at this point show that their action is not as strange as may appear at first. Yellowstone Lake lies just east of the Divide which here is a broadly rounded ridge without marked summits. Adult birds from the nesting places were often observed during the breeding season to rise from the Lake and cross the Divide apparently for the purpose of obtaining food, and pelicans undoubtedly from this colony were observed fishing on lakes southwest of the Divide at the headwaters of the Snake River. A southerly or southwesterly course, east of the Continental Divide, would carry the birds through a very rugged country, with no feeding or even resting places within considerable distance. If any migration route were to be followed east of the Continental Divide, a more natural course would seem to be by the Yellowstone River first northward and then eastward, following the streams of the Missouri drainage into and along the valley of that river.

On the other hand the passes of the Continental Divide for some distance beyond Yellowstone Lake are low and small lakes are numerous. Near here, for instance, is Two Ocean Pass in which it will be recalled Jordan located the ancient transmigration of the trout from Pacific streams into waters of the Atlantic drainage. Once having crossed the Divide the pelicans would find an abundance of marshes, lakes and streams in a continuous series down river valleys into Great Salt Lake and beyond into southern Utah. These would give frequent and needed resting and feeding grounds for the young birds which in their first migratory flight could hardly cover large distances continuously.

Yellowstone Lake is 7741 feet above sea level and the summit of the Continental Divide, which lies only 5 miles straight west from Molly's Island and barely 2 miles from the south arm of the lake, is about 300 feet higher than the water level. Just over the Divide lie Heart, Lewis and Shoshone lakes, from 7100 to 7500 feet above sea level and no one of them more than 5 to 7 miles distant from Yellowstone Lake. These lakes form the ultimate headwaters of the Snake River which might be followed to the southwest. But the banding records do not indicate such a course, and so far as they go, seem to show that the birds pass westward to a region of small lakes directly west of the Park. Red Rock Lake from which a single record comes is north of the Continental Divide and in the basin of the Jefferson River, one of the three main sources of the Missouri. One cannot determine whether this bird was on its way around the mountains into the Missouri River valley and had separated from the rest of the flock or whether it marked the way taken by most or all of the migrating birds. In normal flight the pelicans soared far above the summit of the Divide and may easily have crossed it more than once. A line west from Yellowstone Lake to Red Rock Lake would pass over several other lakes and marshy areas in the 70 miles intervening, and would cross the Continental Divide at least twice. The other five places recorded above lie almost in a direct line south of Red Rock Lake down past Great Salt Lake into central Utah. If the birds had followed down the Snake River valley into the Jackson Hole country they would probably have come into Utah too far south to have reached Mud Lake and Red Rock Lake unless those points represent the line of a group seeking the Missouri but by a most circuitous route. Much more natural would be the route to the westward to Red Rock Lake, thence south to Mud Lake, Swan Lake, Garland, Sterling and Aurora, Utah.

It is certain that some of the colony do winter on the Gulf of Mexico, as one band was returned[1] late in the winter from a bird that had been shot some 80 miles

[1] No. 201,843, Otatitlan, Vera Cruz, Mexico, February 26, 1923.

from Vera Cruz, Mexico. It is highly improbable that this bird crossed from the Pacific Coast over the elevated, mountainous, semi-arid Mexican plateau with its evidently scanty food supply and infrequent resting places for such birds. Two other possible routes suggest themselves at once. Some birds may depart from the main route in Utah and move southeast into the Rio Grande Valley, or a part of the group breeding on Yellowstone Lake may follow a route, as yet unmarked, which would bring them into the Missouri Valley and ultimately onto the Gulf Coast. One good observer in the Park told me that some birds approach and leave the Lake from the north along the Yellowstone River. This may mean a migration route via the Missouri.

Both in 1923 and in 1924 the pelicans approached the Lake directly from the south, having been reported at Jackson Lake about May 1. In 1923 the only birds reported stopped a while on Polecat Creek, a good fish stream tributary to the Snake River and about three miles west of the latter in the Park. In 1924 some birds were on the Upper Yellowstone River on May 10, and a group of about 40 was reported from West Yellowstone on May 4. These records conform to the view that the birds approach the lake in the spring by two diverse routes, one up the Snake River and the other from the westward along the route followed in migrating south in the fall. They do not enter the lake until the ice disappears, about June 1, or earlier in some years. Further evidences of the movements of these birds will be awaited with great interest.

I am greatly indebted to Mr. F. C. Lincoln of the United States Biological Survey for important data and valuable criticisms incorporated freely at his suggestion in this paper.

University of Illinois, Urbana, Illinois.

VIGOR, DISTRIBUTION, AND PIGMENTATION OF THE EGG

By CHARLES K. AVERILL

IN Chapman's *Handbook of Birds of Eastern North America* it is stated (revised edition, 1912, p. 79) that "fully adult, vigorous birds probably lay larger and more heavily pigmented eggs and more of them than their younger or weaker fellows." Without considering the origin of this belief it seems possible to put it to test as far as pigmentation is concerned by applying it to seasonal migration; for those birds that have acquired breeding ranges well to the north and are forced to make long migrations would be likely to have more vigor than non-migrants or those making short migrations, and would have eggs with more pigment.

A little reflection shows that the distance traveled in their annual journeys is not the only factor to be considered. Not only would the most vigorous push farthest north but they would spread out east and west. We may best express what the statistics will show by saying that pigmentation is related to distribution. It will be seen that in birds of the same family or genus, in a large number of cases the egg with the least pigment belongs to the bird with the restricted range. Since western North American birds have shorter migrations than eastern, and southern birds shorter than northern, it will be seen that the great majority of paler or whiter eggs in the following statistics will be found in the southwestern United States, a region where migration is at a minimum among North American birds.

A number of families of birds have nothing but unpigmented eggs, as swifts, kingfishers, woodpeckers, owls and hummingbirds, and are therefore not available