

southern Mexican and Central American forms of this genus are so imperfectly known and understood, however, that any general treatment of the genus must be at this time regarded as tentative, and for the present it seems best to consider *obsoletus* and *guadeloupensis* as specifically distinct.

*Specimens examined.*—*Salpinctes o. obsoletus*: Nevada, 22; Arizona, 18; Oregon, 1. Mainland of California: Modoc County, 17; Amador County, 1; El Dorado County, 1; Alameda County, 2; Tehama County, 2; Kern County, 9; Tulare County, 2; Fresno County, 1; Ventura County, 2; Los Angeles County, 46; San Bernardino County, 30; Riverside County, 13; San Diego County, 1; Colorado River between Needles and Yuma, 9. Island localities: San Clemente Island, 4; Santa Catalina Island, 2; Santa Barbara Island, 8; Santa Cruz Island, 6; San Miguel Island, 2; Coronado Islands, Lower California, 5; San Benito Island, Lower California, 1; Cerros Island, Lower California, 1; Idefonso Island, Lower California (east coast), 6. *Salpinctes o. pulverius*: San Nicolas Island, California, 34 (12 adults, 22 juveniles). *Salpinctes g. guadeloupensis*: Guadalupe Island, Lower California, 6 (5 adults, 1 juvenile). *Salpinctes g. proximus*: San Martin Island, Lower California, 1 adult. Total number of specimens, 253.

## LITERATURE CITED

- American Ornithologists' Union Committee, J. A. Allen, Chairman and Editor.  
 1910. Check-List of North American birds. Ed. 3, revised (New York, American Ornithologists' Union), 430 pp., 2 maps.  
 Grinnell, J.  
 1898. The San Nicolas rock wren. *Auk*, xv, no. 3, pp. 237-239.  
 1902. Check-list of California birds. *Pacific Coast Avifauna*, no. 3, pp. 1-92, 2 maps.  
 Ridgway, R.  
 1904. The birds of North and Middle America. U. S. Nation. Mus., Bull. 50, part 3, pp. xx+801, 19 pls.  
 Willett, G.  
 1912. Birds of the Pacific slope of southern California. *Pacific Coast Avifauna*, no. 7, pp. 1-122.  
*Los Angeles, California, July 18, 1914.*

## A SURVEY OF THE BREEDING GROUNDS OF DUCKS IN CALIFORNIA IN 1914

By HAROLD C. BRYANT

WITH NINE PHOTOGRAPHS BY THE AUTHOR

(Contribution from the University of California Museum of Vertebrate Zoology\*)

### CONTENTS

Introduction.....	218
Los Baños, Merced County, California.....	219
Gridley, Butte County, California.....	227
Link River, Klamath County, Oregon.....	228
Tule Lake, Oregon and California.....	229
Lower Klamath Lake, Oregon and California.....	230
Numbers of ducks now and formerly.....	233
Market hunting .....	233
Local distribution of ducks in California.....	234
Our native breeding stock of ducks as compared with the winter supply of migratory ducks .....	235
Success and failure among nesting ducks.....	235

\*The field work herein reported upon was made possible through kindly interest on the part of Associate Justice F. W. Henshaw, of San Francisco, and Fish and Game Commissioner M. J. Connell, of Los Angeles. These gentlemen and certain of their friends joined in furnishing the funds needed to defray the contingent expenses.—J. G.

## INTRODUCTION

In connection with a study of the game birds of California now being made by Dr. Joseph Grinnell and the writer under the auspices of the University of California Museum of Vertebrate Zoology, the opportunity was taken the past spring to investigate the more important breeding grounds of ducks within the state of California. The purpose of the undertaking was to determine the kinds and numbers of ducks and certain other native game birds nesting within the state and also to obtain all possible knowledge as to the present conditions under which they breed. The limited amount of information upon record as to past conditions shows the importance of securing definite data concerning conditions as they are right now. That this information may be available as needed in the future has been the prime incentive in this work.

The writer and his assistant, Mr. John N. Kendall, left the Museum on May 11, 1914, for Los Baños, Merced County. Here we stayed till May 24 when



Fig. 62. WHERE DUCKS NEST; NEAR LOS BANOS, MERCED COUNTY, CALIFORNIA; MAY 18, 1914.

we moved to Live Oak, Sutter County, and spent the 25th near there on the grounds of the Noyes Gun Club. The next three days we studied conditions in the vicinity of the Gridley Gun Club across the line in Butte County. May 29 we left for the Klamath region, arriving at Klamath Falls, Oregon, the same night. The marshes along Link River were investigated on May 30. From here we staged to Merrill, Oregon, and camped the following three days on Colwell's ranch at the mouth of Lost River. On the third of June we moved camp to White Lake, a former town-site about three-quarters of a mile north of the California-Oregon line. On June 6 we drove twenty-two miles around the south end of Lower Klamath Lake to the mouth of Willow Creek near Brownell, Siskiyou County, California. Here we camped until leaving for home on June 10.

We were thus enabled to visit three of the best known breeding grounds of ducks in the state: the vicinity of Los Baños, in the San Joaquin Valley; the vicinity of Gridley, in the Sacramento Valley; and the famed breeding grounds of the Klamath Lake region.

#### LOS BANOS, MERCED COUNTY, CALIFORNIA

Our stay at Los Baños covered a period of nearly two weeks, May 11 to May 24. We were quartered at the club house of the Los Baños Gun Club situated at Gadwall, six miles southeast of Los Baños. Here we were in the heart of the best duck country and found conditions favorable to our work.

Practically all of the land in the vicinity of Los Baños is owned by the Miller and Lux Company. By taking water from the San Joaquin River near Mendota and carrying it northward along the hills in two large canals this company has brought large areas of land under irrigation. All of the sections of land which are at all level have been enclosed in levees and are successively flooded so as to cause a continual growth of grass on which cattle are pastured. About 150,000 head of cattle are pastured on this "swamped land" in the vicinity of Los Baños. The water in flooded fields varies from a few inches to about four feet deep. In the shallower places sedge (*Carex* sp.), rushes (*Juncus* sp.), and salt grass (*Distichlis spicata*) spring up, whereas tules (bulrushes and cattails) grow in the deeper parts. The commonest aquatic plant is the yellow water-weed (*Jussiaea californica*). The higher portions of land which cannot be flooded are covered with Kern greasewood (*Spirostachys occidentalis*). A few sloughs lined with tules carry the surplus water off towards the river.

We find, therefore, that these breeding grounds for ducks and other birds have been made available through the efforts of man to produce pasturage for cattle. The country is especially well suited to those ducks which choose small sedge-covered islets (see fig. 62) or dense clumps of tules in which to nest.

For many years this region has been known as the best of the duck breeding grounds in the state, as well as the best of the loafing grounds for waterfowl during the winter. This has been the region where market hunters have most persistently operated. Its distance from the larger cities has alone prevented its more wide use for gun club preserves. It has also long been the Mecca of those ornithologists and oologists who were most interested in waterfowl. In spite of the activities of such men, however, little has been written as to the results obtained. The best account of the ornithology of this region yet published is to be found in F. M. Chapman's "Camps and Cruises of an Ornithologist" in which an altogether too brief chapter is devoted to "The San Joaquin Valley at Los Baños". This one account affords information as to previous conditions (in 1903) in this locality.

**Anas platyrhynchos.** Mallard. We personally saw but a very few Mallards in the vicinity of Los Baños, though we were told that the species nests in some numbers along the larger sloughs near the river. We discovered no nests, but succeeded in finding two broods of young. On May 12 while crossing a foot bridge across a slough I frightened from a nearby clump of tules a female Mallard with a brood of half-grown young. Some of these dove, while others flopped along the surface of the water. This brood was thought to be at least two weeks old and the eggs must therefore have been laid about the first week in April. A day or two later what was probably part of the same brood was seen in the same locality. On May 18 a female Mallard with a brood of about ten downy young, seven or eight inches long, was noted scurrying across

a bit of open water in a large pond. As soon as the young were securely hidden in a growth of sedge the mother flew over towards us and attempted to distract our attention. Although we searched the patch of sedge carefully we were not able to locate any of the young. Another brood of downy young was reported to us. All of the evidence obtained points to the conclusion that, even so early as the middle of May, many Mallards were already through nesting. The downy young are much like those of the Cinnamon Teal, but can be distinguished by the presence of more yellow on the sides of the head and by the broader bill.

**Dafila acuta.** Pintail. Four nests of the Pintail were examined. One found on a small islet had been destroyed by some animal, for the broken egg shells were found scattered about. Another nest found had been trampled by cattle. On May 22 a Pintail was seen to flush from her nest as an automobile passed by. The nest was situated about twenty yards from the nearest water and but forty feet from the main county road. It was but poorly concealed, being surrounded by salt grass only about six inches high. The nest, contain-



Fig. 63. DOWNY YOUNG OF PINTAIL (*Dafila acuta*); LOS BANOS, MAY 21, 1914.

ing seven fresh eggs, was constructed of short grass stems and sparsely lined with dark-colored down. On returning to this nest on the morning of the 24th we found that some animal had been there before us. Only four whole eggs remained, while broken and empty shells were scattered about (see fig. 70). The fourth nest was reported to us as containing eight fresh eggs on May 23, and as being located in salt grass within fifty feet of the margin of a large pond.

In all, three broods of the Pintail were found in this locality. The first brood was discovered along with the mother in some shallow water near a tule-grown slough. The downy young all at once started for the shelter of the tules, while the mother flopped into the water not more than ten feet away from me and did her best to lead me in another direction. The brood numbered seven or eight individuals about nine inches long though there was considerable variation in size. On May 21 a Pintail with ten downy young was discovered on the bank of a pond. When first disturbed she was brooding her young on dry ground about ten feet from the water. The moment she flew the downy young assumed rigidly the same poses they had variously held be-

neath the mother. Some were standing nearly erect whereas others were crouching, but all were huddled close together. They remained perfectly motionless while, leaving Kendall to watch, I went for the camera. I had gone over a hundred yards before they moved. By the time I returned they had



Fig. 64. NEST OF BLACK-NECKED STILT (*Himantopus mexicanus*): A CRUDE AFFAIR BUILT FLAT ON THE GROUND; LOS BAÑOS, MAY, 1914.

wandered off about ten yards. They marched in single file and every now and then huddled close together posing motionless for a few moments. The mother came within twelve feet of us a number of times. She repeated from time to time a sonorous *quack*; but when we moved to a little distance she approached the ducklings and began calling them with a rapid series of short quacks, to which the young responded by quickly following their mother as she waddled off to the nearest water. Another brood of almost the same age was discovered on the afternoon of the same day, the 21st (see fig. 63). The wind was blowing hard and the mother with her eight downy young had sought the shelter of a bush on the bank of a large pond. She was very solicitous for her young, and in her attempt to lead us away she fluttered along the ground, flew about our heads, or swam in anxious manner in the nearby pond.

The Pintail evidently nests commonly in the vicinity of Los Baños. The almost equal number of sets of fresh eggs and broods of downy young found lead us to conclude that our visit there occurred during the height of the breeding season. The downy young have so little yellow about the head, and the



Fig. 65. NEST OF BLACK-NECKED STILT: A WELL CONSTRUCTED EXAMPLE, BUILT UP WELL ABOVE SURFACE OF WATER TO ESCAPE FLOODING; LOS BAÑOS, MAY, 1914.

two dark lines on the side of the head are so conspicuous, that there is little trouble in distinguishing them from the downy young of the Mallard or Cinnamon Teal. Like the young of the Mallard the young Pintail is an expert diver. Two kept for a time in captivity were very fond of house flies and were

extremely adept in catching the insects as dropped into the cage. The stomachs of the young Pintails examined contained grass and other plant stems, seeds of filaree (*Erodium*) and certain other unidentified seeds in fragments. One stomach contained the remains of the pupa of some insect.

**Chaulelasmus streperus.** Gadwall. Four nests of the Gadwall were found. From one of these the young had already hatched, and one of the others had been raided by some animal, probably a coon. On May 12 a female of this species was flushed from her nest which was situated in tall salt grass about fifteen feet from a small pond and lined with gray down. It contained nine cream-colored eggs. When flushed the duck gave a few quacks, dropped into the nearby pond and, swimming low in the water, quietly departed. Five days later the nest was destroyed by some animal. On a small island grown up with sweet clover and grass the fourth nest was found on May 16. This nest was constructed of the leaves of sweet clover mixed with dark gray down and was well concealed by the high growth. The outside diameter was 21 inches and the inside 16 inches. The nest contained twelve slightly incubated eggs. No downy young were found by us.

Besides the two birds which were flushed from their nests, not more than two or three other Gadwalls were identified with certainty in the field. Hence we must consider this species as comparatively uncommon during the nesting season in this vicinity. The number of nests found did not furnish in this case an adequate criterion of the number of nesting birds of the species. The birds when flushed remind one of Pintails but appear to be of stockier build and much shorter neck. The eggs differ from those of the other ducks found nesting at Los Baños in that they are of a distinct cream color. The stomach of one adult examined contained one carabid beetle and a quantity of grass blades. The stomach contents was very similar to that usually found in the Baldpate.

**Querquedula cyanoptera.** Cinnamon Teal. Twenty-three nests of the Cinnamon Teal were found. Of this number eighteen were destroyed by some predaceous animal, and from three, the young had already hatched. This duck almost invariably chose for nesting sites small islands or the banks of ponds upon which grew either sedge or salt grass. A typical nest found on an islet in a marsh was well concealed in a patch of bunch-grass about a foot high. It was well lined with down in spite of the fact that the eleven eggs were fresh. Two other nests discovered, which were afterward destroyed through some agency, were exactly the opposite in respect to the equipment of down: one containing five eggs held no down as yet, the other containing but one egg showed a moderate lining of down. A nest found in a dense clump of tules at the edge of a pond contained one egg when first found. Four days later the same nest contained five eggs, giving evidence that one egg is laid each day. It is interesting to note that two individuals of the same species will choose such different nesting sites as grassy islands and dense tules, and such different nesting materials as grass and tules. The choice of tules by Cinnamon Teal in the vicinity of Los Baños is certainly the unusual thing.

The inconspicuousness of a nest when covered with its blanket of down was significantly impressed upon us on returning to a nesting site we had previously marked. Although we went directly to the small islet on which the nest was situated and looked carefully for the nest it took several minutes to descry it, and when found it was in exactly the position we had pictured it in our minds. The dusky-hued down of the Cinnamon Teal harmonizes wonder-

fully with the damp black earth on which the nest is most often directly placed.

Four broods of downy young Cinnamon Teal were seen, and a "flopper", about half-grown, which represented another brood, was noted. In no case did the broods number more than eight and most of them numbered six or seven. The downy young look much like those of the Mallard, both species having extensive yellow on the sides of the head. In the specimens of Cinnamon Teal at hand, however, the dark-colored stripes on the sides of the head are not so conspicuous and the stripe between the base of the bill and the eye is indistinct. The bill, too, is narrower. The broods were invariably found along the marshy margins of ponds, these constituting their preferred forage grounds. The stomach of a young one contained parts of one seed which was so ground up that identification was impossible.

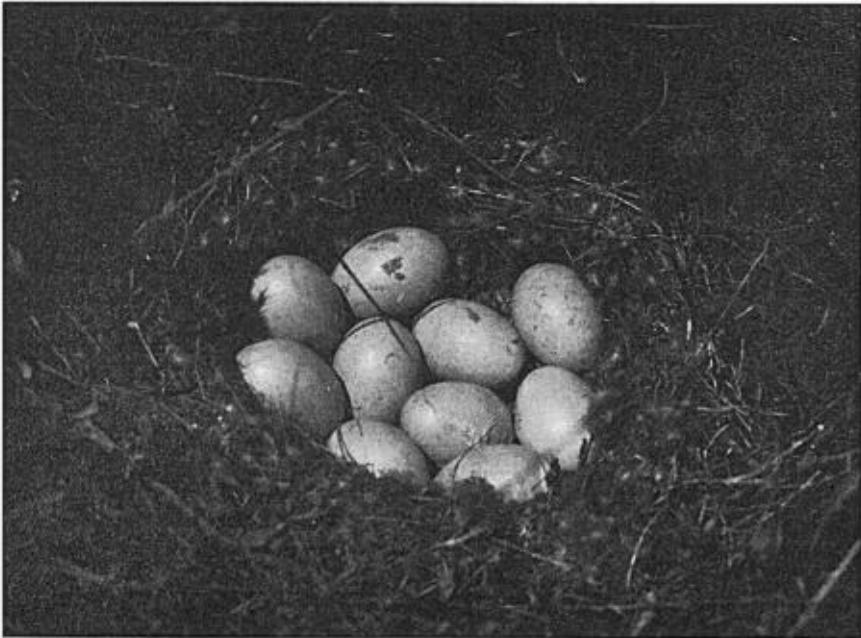


Fig. 66. NEST AND EGGS OF PINTAIL (*Dafila acuta*); NEAR PENNINGTON, SUTTER COUNTY, CALIFORNIA; MAY 25, 1914.

The Cinnamon Teal is the commonest duck at Los Baños during the summer. In a three hours walk an average of twenty individuals could be counted. During the period of our stay, by far the greater majority were seen in pairs, and this seems to show that many had not yet begun to nest. In several instances males were observed paying court to females, and in one case a fight between two males was witnessed. Combatants, swimming on the water, would face each other about a foot apart, and make lunges at each other, using both bill and wings as weapons. Occasionally one of the birds would avoid attack by diving, allowing the other to jump completely over him. Cinnamon Teal were the tamest of the ducks found in this vicinity. Occasionally a person could approach within twenty feet of a feeding pair. The male is apparently silent; the female is the one which quacks and is always the first to take alarm and fly.

***Erismatura jamaicensis*.** Ruddy Duck. Ruddies were commonly seen in pairs in the deeper sloughs and larger ponds near patches of tules. A nest containing four eggs was found on a small sedge-covered island on the rim of an earth duck blind. The nest was simply a crushed-down place in the sedge, there having been no obvious attempt to make use of building material. There was a very little lining composed of large whitish down-feathers. Very little attempt at concealment could have been made in this case, for the large white eggs were in plain sight when the nest was still eight feet from the observer. A pair of Ruddies was nearly always to be seen near the nesting site. The facts that this species was nearly always seen in pairs and that we found only the one nest, and that one with an incomplete set, led us to believe that the season of nesting with the Ruddy Duck was not yet well under way.

***Dendrocygna bicolor*.** Fulvous Tree-duck. One of our most interesting finds was a nest of the Fulvous Tree-duck, discovered on May 12, 1914. The nest was situated on a hummock in the middle of a marsh between two ponds. The nest was a well-woven one of dry sedges placed about six inches above the ground in a tall clump of sedge and weeds. The cavity was about five inches deep and in it lay twelve ashy white eggs. A few days later the nest was raided by some predaceous animal and all the eggs destroyed. On May 18 we discovered a second nest in the same swamp. This one was built about six inches above the water in a small clump of sedge and contained but four eggs. The sedges were arched over the cavity in such a way as to conceal it effectively. Two days later when we visited this nest we found it also raided. The only other nest of this species noted was a new one found on June 23. No attempt had been made at special construction of a nest, the two eggs simply lying in a crushed-down place among tall sedges.

Fulvous Tree-ducks were much more numerous at the end of our stay than at the beginning. The last few days several small flocks were seen and these may very probably have been new arrivals. In a large flooded field several Tree-ducks were flushed but no nests were found. It seems certain that the nesting season for this species had but just begun. Compared with the numbers of Fulvous Tree-ducks seen by the writer in the same locality on July 16, 1912, the numbers summering here now would seem to be less, even considering the fact that many seen in 1912 were young.

The gizzard of an adult Tree-duck taken contained finely triturated grass and other vegetable matter.

Other ducks.—A pair of ducks swimming about at the edge of some tules in a large pond proved to be Green-winged Teal. The male was a cripple and unable to fly and probably the female was also. This male bird had been feeding on the seeds of sedge (*Carex* sp.). More than one hundred seeds were found in the gizzard.

Redheads (*Marila americana*) are known to nest in some numbers in the vicinity of Los Baños, but we were not successful in locating a nest ourselves. On one large pond surrounded by tules we found on several different occasions seven Redheads, four males and three females. During a morning's trip to some large tule-bordered ponds about twenty Redheads were seen. These birds seemed to be in pairs and there were usually more males than females seen, which led us to think that some of the females might be incubating.

Shovellers (*Spatula clypeata*) were even less common birds than Redheads. Pairs were occasionally seen feeding in shallow, muddy ponds out in the brush, and on one occasion three full-plumaged males were seen disporting themselves



in a little open water near a dense growth of tules. Attempts to locate a nest of this species proved unavailing.

**Fulica americana.** Coot. Next to Black-necked Stilts, Coots were the most numerous nesting birds in the vicinity of Los Baños. A record was kept of the general location of each nest found, material used in construction, and the numbers of eggs. On our arrival May 11 many new nests were found nearing completion. On our departure most of the nests contained eggs. We were therefore led to believe that the nesting season was fully inaugurated by the middle of May. Only five broods of young were noted during our stay at Los Baños, while more than fifty nests were found.

RECORD OF COOT'S NESTS FOUND AT LOS BAÑOS

Location	Material	Date	Number of eggs
1. In sedge .....	Sedges	May 13	6
2. " " .....	"	" 14	9
3. " " .....	"	" "	9
4. In tules .....	Tules	" "	3
5. In dock weed.....	Sedges	" "	5
6. At edge of tules.....	Tules	" 16	3
7. On aquatic plant.....	Sedges and aquatic plant	" "	5
8. In tules .....	Tules	" "	6
9. In wire grass.....	Sedges	" "	6+1 young
10. On aquatic plant.....	"	" "	4
11. In low tules.....	Tules	" 18	4
12. In tules .....	"	" "	9
13. In sedge .....	Sedges	" "	4 (2 pipped)
14. " " .....	"	" "	8
15. " " .....	"	" "	1 (pipped)
16. " " .....	"	" "	1+others hatched
17. " " .....	"	" "	8
18. " " .....	Tules	" 19	10
19. " " .....	"	" "	8
20. " " .....	"	" "	9
21. In tules .....	Sedges	" "	6
22. In sedge .....	"	" 20	5 (2 pipped) + 1 young
23. " " .....	"	" "	7
24. In tules .....	Tules	" "	2
25. " " .....	"	" "	4
26. " " .....	"	" "	3
27. In sedge and weeds.....	"	" "	8
28. In tules .....	"	" 22	6
29. In sedge .....	Sedges	" "	1
30. " " .....	"	" "	8
31. " " .....	"	" 23	1
32. " " .....	"	" "	8
33. " " .....	"	" "	8
34. " " .....	"	" "	8
35. On aquatic plant.....	"	" "	9
36. In sedge .....	Aquatic plant	" "	1
37. " " .....	Sedges	" "	6
Total .....			37
Number of additional new but empty nests found .....			16
Number of nests with all eggs hatched.....			2
Grand total .....			55

**Plegadis guarauna.** White-faced Glossy Ibis. During our stay large flocks of White-faced Glossy Ibis were seen both feeding and in flight. The numbers appeared to be greater toward the end of our visit. Several of the flocks in which the individuals were counted numbered thirty to forty. From their actions we inferred that they had not yet begun nesting.

Shore-birds.—Black-necked Stilts (*Himantopus mexicanus*) were by far the most numerous of all the breeding birds in the vicinity. They nested very commonly on muddy islands in the larger ponds; but nests were also found along the margins of ponds out in the brush as well as in flooded fields. In such places as last indicated the nests had often been built up so as to reach above the surface of the water. It was suggested to me some time ago by Mr. Paul J. Fair that Stilts alone among all the water birds, seem to have sufficient intelligence to increase the height of the nest in order to keep it from being flooded by rising water. Mr. John G. Tyler attests to the same thing. Evidence which we obtained certainly points in this direction. On the banks of ponds and on muddy islands the nests were usually very simple in structure, being a hollow in the ground lined with a few weed stems. Many nests found above water may well have been of this crude structure before the encroachment of the water. When seen by us, however, they were well constructed nests built up to a height of six to ten inches (see figs. 64, 65). It seems quite possible that extra layers of stems could be added to the nest as it and the eggs were threatened with flooding by the rise of the water. Two nests in which the young were just hatching were noted May 21, but all the rest of the nests contained three or four eggs. Fresh eggs were examined on May 22.

Avocets (*Recurvirostra americana*) were still more partial to the muddy islands than were the Stilts. The former were present in moderate numbers, and a nest containing three eggs was found on May 23. A downy young one several days old was noted on May 21 swimming in a shallow pond and turning tail up as it tried to reach something on the bottom. Its stomach was found to contain eight or more small water beetles (*Dytiscidae*), 1 Jerusalem cricket (*Stenopelmatus*), 1 larva of a dragon-fly, 1 small bug (*Pentatomidae*), and 1 centipede (*Scolopendra*).

Along the muddy shores of ponds five Snowy Plover (*Aegialitis nivosa*) were seen at different times. Three were noted on May 17. Their light brown backs so harmonize with the color of the muddy shores of ponds that it is impossible to see the birds until they move. The stomach of one contained more than ten water beetles (*Dytiscidae*). These birds were very tame and a photograph was taken at a distance of eighteen feet.

A flock of twenty-six Western Sandpipers (*Ereunetes mauri*) was noted on May 17 and two Northern Phalaropes (*Lobipes lobatus*) on May 19.

Killdeer (*Oxyechus vociferus*) nested most commonly on the alkali flats away from the water. When one walked across such stretches as many as ten of these birds could be seen running along ahead or standing "teetering" and incessantly repeating their call. The eggs in one nest found May 15 had been broken on the under side, just as if the weight of the bird, pressing the eggs against the small pebbles forming the floor of the nest, had crushed in the shell. Another nest found on May 15 was unique in the facts that it was placed on a small grassy knoll surrounded by water, and that the cavity was well lined with short stems of devil grass. A downy young one was found May 22.

## GRIDLEY, BUTTE COUNTY, CALIFORNIA

One day, May 25, was spent on the Noyes Gun Club grounds in Sutter County, just west of the Marysville Buttes. The next three days we camped on the grounds of the Gridley Gun Club in Butte County, which joins the Noyes Club on the north. Where Butte Creek enters the Sacramento River bottom it divides into a number of sloughs, and during high water large areas of the adjacent lowlands are flooded. The sloughs are lined with reeds and tules in which Mallards and Shovellers are known to nest. A growth of timber along the creek affords nesting sites formerly occupied, as we were told, by Wood Ducks, while the grass-covered flats near the sloughs furnish nesting sites for Cinnamon Teal and Pintail. Northwest of the Marysville Buttes are extensive mud flats covered with grass. During migrations these flats become loafing grounds for geese, and it is here that geese are said to be seen at the proper seasons in greater numbers than anywhere else in the State. During the late spring and summer these same flats furnish excellent breeding grounds for such ducks, like the Pintail, which nest at some distance from water. Abundant food is to be found in the nearby sloughs and ponds where there is heavy plant growth.

**Anas platyrhynchos.** Mallard. A nest well concealed in tall sedge and found on a small island on May 26 contained one infertile egg and egg-shells from which the young had hatched. A brood of young discovered on the 25th were fully ten inches in length and the primary wing-feathers were just starting. Members of another brood, found on the 27th, were not more than seven inches in length. When diving to escape capture they would often cling to the weeds beneath the surface, and when finally forced to come to the top for air would expose to view the top of the bill only. They tried to escape by simply diving and clinging motionless to weeds more often than they attempted to swim long distances under water.

Mallards were the commonest ducks in the vicinity of Gridley. Most of them were seen in pairs, but not a few lone males were noted. Hatched eggshells and broods of downy young showed that many of this species were already through nesting. Those seen in pairs were doubtless the latest of the nesters.

**Dafila acuta.** Pintail. While crossing some grassy fields the auto in which we were riding startled a Pintail from her nest situated within two inches of the wheel tracks. The nest was typical, being built of grass and lined with down. It contained ten eggs (see fig. 66). Although we dragged with a rope several acres in the vicinity of this nest we were not able to locate another. A shepherd told us that he had discovered a number of nests to the westward of this place. From the numbers seen the Pintail must be a fairly common nesting duck on the "goose grounds".

**Querquedula cyanoptera.** Cinnamon Teal. In this vicinity I should say that the Cinnamon Teal ranked about third in abundance, the Mallard coming first and the Pintail second. But one nest was found. This contained nine fresh eggs and was situated on the same island on which the Mallard's nest with hatched eggs was found and only about six feet from the latter. The nest was unusually well concealed in tall sedges, there being an arched runway from the water to the nest, the distance being but little more than one foot. There was no down, or other lining.

Other ducks.—A number of Shovellers (*Spatula clypeata*) were seen, but

no nests or young were found although the tules were carefully searched. Fulvous Tree-ducks appeared to be wholly absent. Not a single Ruddy was seen, and no Wood Ducks. Two or three Coot's nests were found, but we did not find this bird nesting abundantly in this locality.

Shore-birds.—Five or six Black-necked Stilts (*Himantopus mexicanus*), which did not act as if they were nesting, one Killdeer, and a small flock of Western Sandpipers, were the only shore-birds seen. Apparently the conditions are nowhere near as ideal in this locality for nesting shore-birds as they are at Los Baños.

#### LINK RIVER, KLAMATH COUNTY, OREGON

Link River is the outlet from Upper Klamath Lake. Extensive tule swamps and marshes line the river for miles. This locality, where we spent but one day, May 30, proved to constitute about the best breeding ground visited

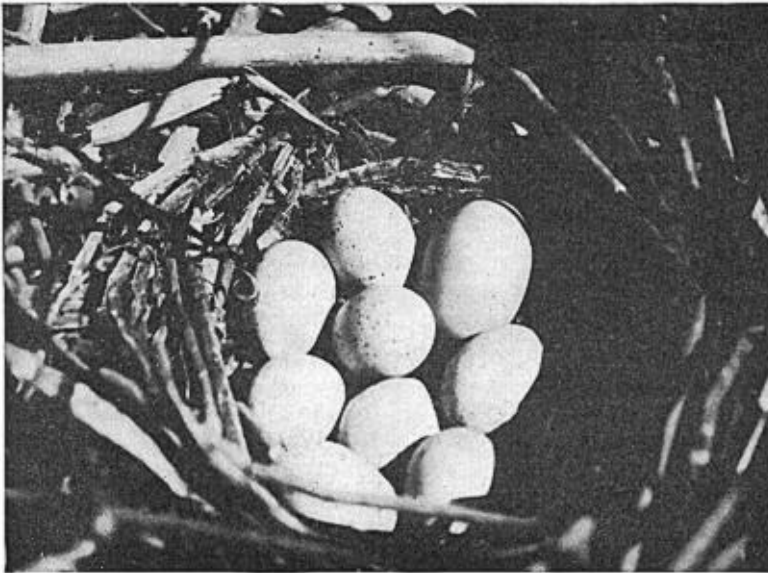


Fig. 67. NEST OF COOT (*Fulica americana*) CONTAINING EIGHT EGGS OF THIS SPECIES AND ONE EGG OF THE REDHEAD (*Marila americana*); TULE LAKE, NEAR MERRILL, KLAMATH COUNTY, OREGON; JUNE 2, 1914.

during the whole trip. In the tule-bordered ponds Mallards, Redheads, and Ruddies were extremely abundant. On one pond alone we counted over seventy-five ducks.

**Anas platyrhynchos.** Mallard. The Mallard was the most abundant duck seen and without doubt the commonest nester. A brood of downy young was met with on May 30 at the margin of a pond. They disappeared so quickly by diving that it was impossible to count them.

**Marila americana.** Redhead. Redheads were far more numerous in this locality than at Los Baños or Gridley. On one small pond a brood of about ten very small downy young were seen swimming along behind their mother. She led them into some tules where they successfully eluded our search for them. In color the small downy young are a dark reddish brown, a character which enables one to distinguish them at a distance.

Shore-birds.—Two or three pairs of Avocets (*Recurvirostra americana*) were seen and one nest was found. This was placed in the middle of a grassy island. Killdeer (*Oxyechus vociferus*) were common nesters in the vicinity, and a man reported that he had seen several downy young. Around one pond were about fifteen Stilts which behaved as though nesting.

#### TULE LAKE, OREGON AND CALIFORNIA

Tule Lake is surrounded by lava beds, and lacks the needed growth of vegetation on its shores to make it a favorable nesting ground for ducks. Along the north shore, near the mouth of Lost River, in Oregon, there is some marsh land and a good growth of tules; but on the other sides of the lake sage-covered lava hills rise abruptly from the water's edge. Even under such circumstances, Mallards are reported to nest, selecting sites out in the sage brush away from water. While in this locality, June 1 to 3, we camped on

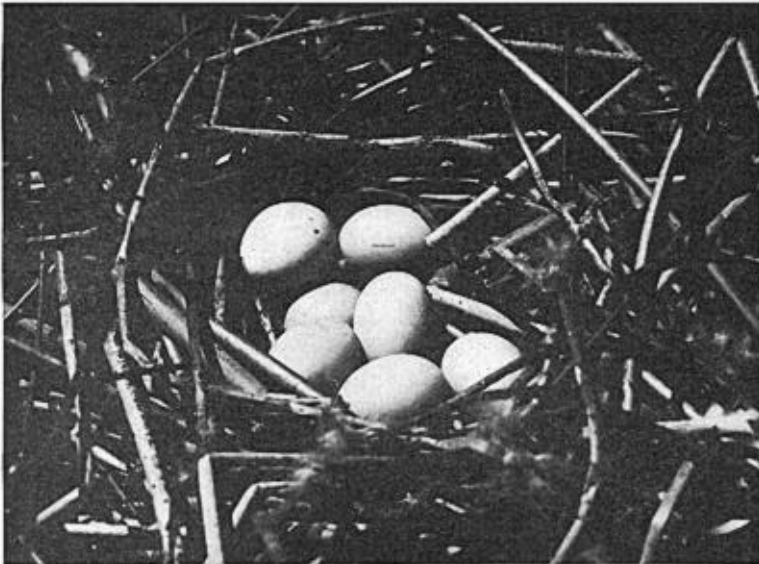


Fig. 68. NEST OF REDHEAD CONTAINING SIX EGGS OF THIS DUCK AND ONE EGG OF THE RUDDY DUCK (*Erismatura jamaicensis*); TULE LAKE, OREGON; JUNE 2, 1914.

Colwell's ranch near Merrill, Oregon, at the mouth of Lost River. From this point we were able to work the north shore in Oregon and the west shore over the line in California.

**Anas platyrhynchos.** Mallard. Numbers of Mallards undoubtedly breed along the northern shore. Several lone males and a few pairs were seen, but no nests or young were found.

**Marila americana.** Redhead. In this vicinity Redheads appeared to be more common than Mallards. Flocks of seven to ten were often observed in open places between the tules. A nest newly constructed of green tules contained no eggs; but several feathers in it were certainly those of a Redhead. On June 2 we found a Coot's nest which contained a set of eight eggs of the Coot and one egg of the Redhead (see fig. 67). On the same day we found a nest of a Redhead with six eggs of this duck and one egg of the Ruddy (see fig. 68). The nest was a platform of dried last-year's bulrushes fixed among

standing rushes about six inches above the water. Some gray down-feathers, larger in size, if anything, than those of the Mallard, were in the nest, but the bird had evidently only started to provide the lining: Additional evidence of the well-known fact that Redheads and Ruddies on occasion lay their eggs in other ducks' nests is thus afforded.

**Querquedula cyanoptera.** Cinnamon Teal. A few Cinnamon Teal were seen at the head of Tule Lake. A female was flushed from her nest in the middle of a muddy peninsula on June 1. The nest was a depression lined with broken stems of tules mixed with a quantity of down, and was poorly concealed in a sparse growth of weeds. It contained nine eggs.

**Erismatura jamaicensis.** Ruddy Duck. About eight individual Ruddies were seen during one morning's excursion. A new nest, discovered in a clump of tules where a pair of Ruddies was seen, was thought to pertain to this species. Evidence as to breeding was obtained through the finding of the one egg in the nest of a Redhead, as described above (see fig. 68).

Shore-birds.—Although no nests were found, the actions of Avocets, Stilts and Killdeer showed that they were nesting in the vicinity. Avocets were more abundant than Stilts in this locality. All shore-birds, however, were found in less numbers than at Los Baños.

#### LOWER KLAMATH LAKE, OREGON AND CALIFORNIA

Our camp on White Lake was situated in an old store building at the former town-site of White Lake. This situation was our headquarters from June 3 to 6, and made possible explorations along the western shore of Lower Klamath Lake as well as on White Lake, in both Oregon and California. On the west side of the lake we camped until June 9 on Taylor's ranch at the mouth of Willow Creek, near the town-site of Brownell, Siskiyou County, California. From this point we made a launch trip eight miles north to Bird Island and Sheepie Lake, but we spent most of our time on the freshwater marshes at the mouth of Willow and Cottonwood creeks.

The eastern and western shores of Lower Klamath Lake are very different from one another in character. The eastern is lined with a dense strip of tules that extends into the lake a distance of five or six miles. Ducks were seen flying about over these tule beds and no doubt nest in them, but we found it impossible to search for nests. It was dangerous to wade and the tules were too thick to permit of using a boat. Judging from experience elsewhere, ducks prefer localities where there are frequent open patches of water rather than unbroken stretches of tule growth. A small lake near the eastern shore of Lower Klamath, known as White Lake, is famed as a favorite haunt for ducks during the migrations. Along its eastern shore there are excellent nesting grounds for the ducks which prefer a growth of tules with open water adjacent. As the hills come down to the lake on the southern shore of Lower Klamath, the water is too deep for an extensive growth of tules. The best nesting grounds which we found were on the western side of the lake, in California, where the small streams entering the lake form extensive marshes. The marshes at the mouths of Cottonwood and Willow creeks are due to artificial interference. Excellent conditions are said to obtain at the mouth of Sheepie Creek also. Only a narrow strip of tules fringes the lake on this side except in the vicinity of Bird Island where there are many tule-covered islands separated by channels of open water.

**Anas platyrhynchos.** Mallard. The Mallard is apparently the common-

est duck nesting on Lower Klamath. One nest on White Lake was situated under a sage bush about twenty-five feet from a canal. It contained twelve eggs on June 6 (see fig. 69). One found in a marsh on Willow Creek, also on June 6, was placed in a bunch of cane grass on a sage-covered knoll. The nest was well lined with down in spite of the fact that it contained but four eggs. A fifth egg had been broken in the nest. The bird was evidently incubating, for she was flushed a number of times from the nest, and in one instance she had partially covered the eggs with down before leaving. Another nest found in this vicinity, June 7, was placed in an exposed position at the south side of a boat house, the nest rim on one side being in contact with the boards. It contained nine eggs and we were told that the nest had been there for about three weeks. Three broods of downy young were seen and one or two half-grown young were noted in the same general locality on two or three differ-



Fig. 69. NEST AND EGGS OF MALLARD (*Anas platyrhynchos*) IN SAGE-BRUSH; WHITE LAKE, NEAR MERRILL, OREGON; JUNE 6, 1914.

ent occasions. Males were more often seen than females. As many as ten males were counted in one flock. Two males noted were already assuming the eclipse plumage. The green feathers of the head had been replaced by brown feathers.

**Marila americana.** Redhead. The east side of Lower Klamath Lake abounds in Redheads. More were seen in this locality than anywhere else on the trip. In one flock alone we counted sixteen individuals. In the vicinity of White Lake, Redheads were more common than Mallards. On the west side of the lake the reverse was true. A female closely followed by a brood of small downy young, seen swimming on White Lake June 5, appeared to be of this species.

**Querquedula cyanoptera.** Cinnamon Teal. A brood of five or six small downy young was seen on a small pond on Willow Creek on June 6. The brood

was accompanied by both the male and the female adults. On nearly every small pond in the vicinity a pair or two of this species was to be noted.

Other ducks.—From observation and evidence obtained from interviews, Shovellers and Ruddies nest in some numbers on Lower Klamath Lake. At the mouth of Willow Creek several male Shovellers were noted and several pairs of Ruddies were seen.

**Branta canadensis canadensis.** Canada Goose. Our first Honker was noted on the east side of Lower Klamath Lake where we startled it from the shore. While driving around the lower end of the lake on June 6 we saw a bunch of at least ten half-grown young. Only one adult was seen with them, but two broods were probably represented. On June 7 two other broods were seen near the mouth of Willow Creek. One contained four young and the other five or six. Ranchers of the vicinity reported that Honkers nest every spring in the tules bordering the lake and that they are the first of the water birds to nest. Reports agreed that fewer geese nested on the lake this spring than in former years.

**Plegadis guarauna.** White-faced Glossy Ibis. On June 4 a flock of five or six White-faced Glossy Ibis was seen flying south over Lower Klamath Lake, crossing the line into California. They were close enough so that I could see the long curved bill, and characteristic sailing with wings set.

**Fulica americana.** Coot. On Lower Klamath, Coots were not as numerous as most of the species of ducks. Less than ten were seen during our whole stay on the lake. On June 9 two or three downy young were noted on a pond at the mouth of Willow Creek.

Shore-birds.—The Wilson Phalarope (*Steganopus tricolor*) was first seen on Link River in Oregon. Later, in the Willow Creek marshes on the west side of Lower Klamath Lake, twenty or thirty birds were observed. On June 8, while crossing a pasture I started up a pair of Wilson Phalaropes from the low sedge. They flew excitedly about my head and soon were joined by four more. After a long search I discovered the nest, which was placed on the ground and was built of sedge stems. The shells of four eggs from which the young had hatched still lay in the nest. Wilson Phalaropes were usually seen in pairs feeding in shallow ponds.

**Gallinago delicata.** Wilson Snipe. Our endeavors to find the nest of a Wilson Snipe proved fruitless. On every trip into the marshes on Willow Creek we saw and heard these Snipe as they went through their aerial gyrations. The birds fly high in the air and their whole body appears to vibrate as they dash downward for fifteen or twenty feet and it is at this time that the weird sound so often described is heard. The few which were flushed from the grass were easily identified by their erratic flight. In almost every instance after being flushed they started on one of their aerial trips. On two occasions they were heard long after dark.

**Oxyechus vociferus.** Killdeer. Near the mouth of Willow Creek a Killdeer's nest was found on the shore of the lake on June 9. It was placed in loose sand near a rock which just showed above the general level of the ground. A small depression sparsely lined with dry sticks formed the nest which held four fresh eggs. Mr. C. H. Glaser, a rancher, reported that while hoeing his garden in the near vicinity of this nest he had a few days before accidentally destroyed another nest containing four eggs. On the east shore of the lake, June 4, we discovered a downy young one not more than one or two days old.



It sought shelter in the sage brush, being able to run very fast in spite of its immaturity.

***Recurvirostra americana.*** Avocet. Avocets were nesting on both sides of the lake, but perhaps most commonly on the east side where muddy peninsulas along the edge of the lake furnished desirable nesting sites. Not a single Stilt was seen on Lower Klamath Lake.

#### NUMBERS OF DUCKS NOW AND FORMERLY

Wherever possible, people resident in the vicinity of the places visited were interviewed with regard to the present status of ducks in each locality as compared with previous conditions. In all instances the evidence so obtained pointed to the fact that the numbers of breeding birds have greatly decreased in the past ten years. Mr. C. H. Glaser, a dependable observer who has been located on the west shore of Lower Klamath Lake for the past fifteen years, says that he has noticed a considerable fluctuation in the numbers of nesting ducks, but that there has been a marked general tendency to decrease. Similar statements were current in the other localities visited. Most of the testimony attributed the decrease of the resident birds largely to the market hunting and excessive shooting formerly carried on during the winter.

#### MARKET HUNTING

Many people in Los Baños formerly hunted ducks for the market and almost everyone in the town is able to tell of remarkable kills. A Mr. Becker, with whom I talked, told of seeing Sischo, a famous market hunter of the region, kill 400 ducks with six shots. Sischo and two assistants worked up within range by using steers—"bull-hunting", this method is called. Two discharges from a number four, double-barrelled, muzzle-loading shotgun were fired by Sischo at the birds while they were resting on the water; then his two assistants, each armed with the same kind of gun, fired four more shots as the birds were rising. Mr. Becker who had started to hunt in the neighborhood at the time, was presented with twenty-two ducks as a reward for not disturbing the quarry while the "sneak" was being made. It was also commonly reported that this same hunter and an assistant killed 198 geese in ten shots, using automatics.

When market hunting was at its height trained steers used in hunting commonly sold for three hundred dollars each. Since the law went into effect prohibiting the use of trained animals in hunting any other game birds excepting geese, the market-hunter attempts to escape apprehension as a "bull-hunter" in the following way. He hitches two horses to a light cart, one of which is to be unhitched and used as a movable blind. The harness is so adjusted that this horse can be instantly hitched up again should anyone be seen approaching.

In past years Sischo kept camps of men who spent their entire time hunting for the market. In order to ship large numbers of birds, exceeding the daily legal bag limit, he is said to have paid men one dollar a day for permission to use their names in shipping. Judging from reports, this one hunter shipped as high as 500 birds a day to the markets in San Francisco.

A talk with a market hunter who lives on the east shore of Lower Klamath Lake brought forth the statement that fifteen years ago it was possible to shoot 150 ducks a day and then pick only the more desirable ones such as Canvasbacks and Mallards. It would be impossible at the present time to make such records, even if the law permitted.

The above instances well show the awful slaughter which accompanies the operations of the market hunter. In addition, market hunters as a class are the most persistent violators of the game laws. This factor in the decrease of ducks can be eliminated by the passage and enforcement of radical non-sale laws.

LOCAL DISTRIBUTION OF DUCKS IN CALIFORNIA

The investigation showed a distinct variation in the numbers of the different species of ducks from north to south. Whereas the Mallard was one of the less common nesting ducks at Los Baños, it was the commonest nesting duck in the Klamath region. The Gadwall and Fulvous Tree-duck were found nesting at Los Baños only. The Redhead was found most abundant at Tule and White Lakes. Pintails and Cinnamon Teal were found to nest more commonly in the Sacramento and San Joaquin valleys than in the Klamath region. A difference in the numbers of the various shore-birds was also noted. The following table of censuses taken at the several localities visited will give some idea of the relative abundance of the species of ducks, geese and shore-birds met with. With the ducks, actual counts were made. The numbers of shorebirds are estimates based on memory. The censuses are taken from my notebook, and the circumstance that no birds of a species were recorded as seen does not mean that they did not exist in the region, but simply that they were not seen on the days the counts were made.

COMPARATIVE NUMBERS OF DUCKS, GEESSE AND SHOREBIRDS AS SHOWN BY TYPICAL CENSUSES

Locality	Mallard	Pintail	Redhead	Gadwall	Cinnamon Teal	Shoveller	Tree-duck	Ruddy Duck	Canada Goose	Killdeer	Avocet	Stilt	Coot
Los Baños, Merced Co., Calif.....	10	1	19	6	2	4	..	24	2	30	20		
Gridley, Butte Co., Calif.....	11	2	..	..	2	2	..	..	..	..	6	4	
Link River, Klamath Co., Ore.....	40	4	30	..	25	..	6	..	10	6	15	1	
Tule Lake, Ore. and Calif.....	13	..	17	..	16	2	2	..	14	12	..	2	
White Lake, Ore. and Calif.....	21	..	28	..	2	..	..	..	8	14	..	2	
Lower Klamath Lake near Brownell, Siskiyou Co., Calif. ....	40	..	2	..	4	..	2	1	6	2	..	2	

Some idea of the distribution of nesting ducks as well as their success can be obtained from the following table which lists the number of broods of young of the different species seen at the chief breeding centers.

	Mallard	Pintail	Cinnamon Teal	Redhead	Canada Goose	Coot
Los Baños, Merced Co., Calif.....	2	3	5	..	..	5
Gridley, Butte Co., Calif.....	2	..	..	..	..	..
Klamath Lake region, Ore. and Calif.	5	..	2	1	4	2

In each locality marked preferences were shown among the different species for different types of nesting site. The plant associations represented and the species of ducks nesting in each may be listed as follows:

- Grassy or sedge-covered margins of ponds or islands      Gadwall, Cinnamon Teal, Fulvous Tree-duck
- Rush or tule thickets at margins of lakes, ponds or sloughs      Redhead, Mallard, Ruddy, Shoveller

Grass, grain or alfalfa fields at a distance from water Mallard, Pintail, Cinnamon Teal

Sage or other brush in vicinity of water Mallard

The same sort of preference for particular associations was noted in connection with the shore-birds. Killdeer almost invariably chose the alkali flats or bare dry ground; Avocets were found to choose muddy or grassy islands or margins of ponds, whereas Stilts almost invariably chose the muddy islands or margins of ponds.

In explanation of this associational distribution I need but quote from Grinnell (Univ. Calif. Publ. Zool., 12, 1914, p. 96): ". . . associational restriction appears to be governed by the following three factors, of relative importance in the order named.

"1. Kind of food supply afforded, with regard to the inherent structural powers of each of the animals concerned to make it available.

"2. Presence of safe breeding-places, adapted to the varying needs of the animals, in other words, depending upon the respective inherent powers of construction, defense and concealment in each species concerned.

"3. Presence of places of temporary refuge for individuals, during day time or night time, or while foraging, when hard pressed by predatory enemies, again correlated with the respective inherent powers of defense and concealment of each species involved."

#### OUR NATIVE BREEDING STOCK OF DUCKS AS COMPARED WITH THE WINTER SUPPLY OF MIGRATORY DUCKS

The supply of ducks in California is derived from two seasonal categories of birds, one consisting of those which nest wholly to the north of us and come here only in the winter season, and the other, of those which nest here and either remain throughout the year within our borders or go farther south for the winter. Hunters depend at the beginning of the season chiefly upon the supply of native ducks and always maintain that these are the most desirable for the table. Home bred ducks are nearly all grain feeders and so lack the fishy taste so often found among the northern bred ducks. Numbered among the more desirable resident ducks are the Mallard, Pintail, Gadwall, Redhead and Cinnamon Teal. It is only the native contingent which we are in a position to control during the breeding season. The most important time for applying methods of conserving our duck supply therefore falls during spring and summer. It is a well-known fact that so long as game birds are unmolested on their breeding grounds they are best able to withstand a considerable toll each year. It thus becomes extremely desirable that California direct especial attention to the breeding grounds of the ducks which are strictly her own, and over which she exercises control at all seasons. If the native stock could be well conserved there would always be a supply which could be depended upon no matter what became of the winter birds. Our summer birds, too, are those likely to be seen and studied by the summer vacationist and which therefore give most pleasure to those people who do not hunt.

It is pre-eminently the duty of the State to conserve our native ducks, first, because they are highly desirable as food, second, because they are altogether our own and under our control, and third, because our native ducks are the ones available during the most favorable season for esthetic enjoyment by the people of the state.

#### SUCCESS AND FAILURE AMONG NESTING DUCKS

There are many factors which contribute to the success which attends

the nesting duck. Such a factor as weather is beyond our control. Others, such as predaceous animals, the market hunter, and encroachment of agriculture are within our control. At Los Baños we found that predaceous animals were destroying a very large percentage of ducks' nests. The following table will make clear how great the destruction really was.

	Pintail	Gadwall	Cinnamon Teal	Fulvous Tree-duck	Coot	Killdeer
Undestroyed nests.....	1	3	1	47	4	
Destroyed nests.....	3	3	18	2	2	1

In one locality where the water had lowered and allowed the approach of animals to what had been sedge-covered islets we found ten destroyed nests as a result of two hours searching. In most cases every egg had been broken into and the contents eaten. Of course the broken egg-shells made these destroyed

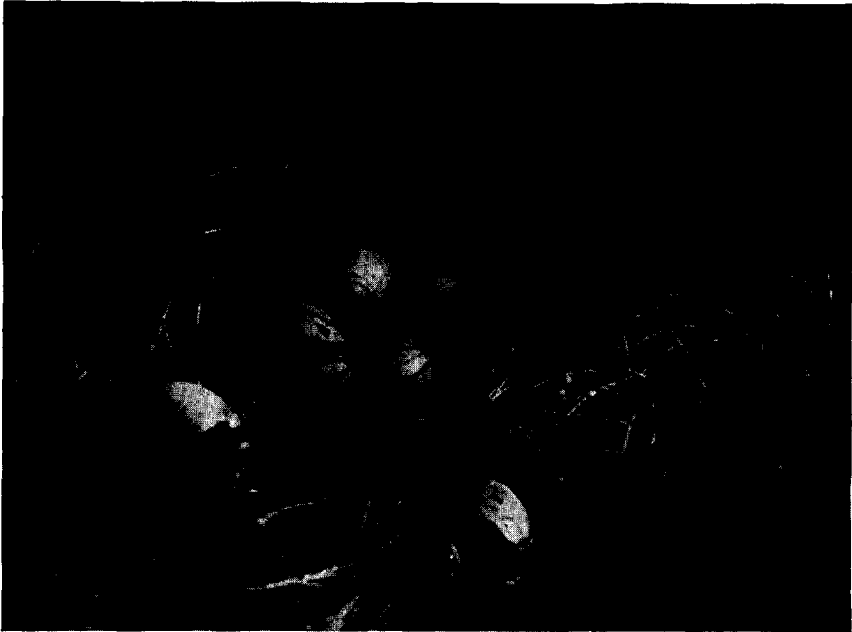


Fig. 70. RAIDED NEST OF PINTAIL, THE WORK OF SOME PREDACEOUS MAMMAL; LOS BANOS, MAY 24, 1914.

nests infinitely easier to find, so that the relative number of destroyed and undestroyed nests is doubtless somewhat exaggerated. Nevertheless, it clearly demonstrates the fact that large numbers of nests in this vicinity are destroyed by animals. In no other of the localities visited did we find a single nest which had been raided.

We experienced no difficulty in distinguishing nests destroyed by predaceous animals from those from which the eggs had hatched. In the former case the shells showed plain evidences of having been broken from the outside in, were usually more widely scattered about, and often contained a small part of the contents. Hatched eggs, on the other hand, had been fractured from the inside out and were usually broken up into small pieces or left in halves.

Time and again on returning to a nest to photograph it we were disap-

pointed to find that it had been destroyed. Let me cite several instances. We marked a Cinnamon Teal's nest containing five eggs and a Gadwall's nest containing nine eggs. On returning we found both of them raided and every egg destroyed. A Pintail's nest found one day, when examined the next morning was found to have been raided and all but four eggs destroyed (see fig. 70). On one occasion we found a Cinnamon Teal incubating three eggs, while around the nest there were evidences that several other eggs had been destroyed. On returning to the nest later we found that two other eggs had been removed and the bird had deserted her nest. A Fulvous Tree-duck's nest containing twelve eggs and well concealed on a weed-covered island was raided during our stay and every egg broken.

Our attempts to find out the particular species of animal doing the work proved unavailing. In most instances nests were placed in a growth of grass or sedge where no tracks were discernible. In other cases the soft mud at the bottom of the shallow water did not permit tracks to remain long in evidence. Raccoons were extremely common, and in some places near clumps of tules paths were found where their foot prints were plentiful. The fact that in some cases the animal had to wade through water to reach the nest which we found destroyed, also lends support to the theory that coons were largely responsible for the depredations. A number of weasels were seen during our stay, and coyotes were said to be common. It is possible that these two predaceous animals also took part in the destruction of nests.

Irrigation as practiced at Los Baños is also responsible for the destruction of many nests. Mr. Paul J. Fair, who has worked in this vicinity for some time, told me that he found many inundated nests. In some places the water was clear enough for him to see nests and eggs completely submerged a foot below the surface of the water. Dr. Frank M. Chapman, when visiting this locality in the summer of 1903, found similar conditions. He states: "Evidently the abnormal and sudden rise of the water, as well as the equally unusual fall, prevents many birds from rearing young. I found numbers of flooded nests in May, which had been built when the water was still rising, while disappearance must have been even more disastrous." Water is continually rising or lowering. The rising of the water floods the nests and the lowering allows the approach of predaceous animals to the nesting sites.

Still another factor is found in the large herds of cattle which are pastured here. We found two nests which had been trampled by cattle, and Mr. Fair tells me that he also found several nests which had been destroyed in like manner.

A rather remarkable state of affairs therefore exists in this locality. The nesting grounds were made available by the formation of pasture land out of originally arid plains, and yet the same factor, irrigation, instrumental in creating these excellent grounds, is responsible for the destruction of many nests.

The reclamation, even of swamp land, does not always entirely destroy the nesting grounds of ducks. A letter from Mr. Wm. N. Dirks dated May 18, 1914, records the discovery of two nests of Mallard, one of Pintail and five of Cinnamon Teal. These were uncovered while the grain was being mowed on a ranch at Alvarado, Alameda County, California. On Lower Klamath Lake we were told by a rancher that he had found several Mallard's nests in his rye field earlier in the season. Other ranchers told us that Mallards and Teal commonly nested in grain and alfalfa fields. It is certain, therefore, that some of our ducks adapt themselves to changed conditions.

If the added area of available breeding grounds provided through extended irrigation of land does not remain equal to the area of land rendered unfit for nesting it is evident that our breeding ducks must either adapt themselves to the new conditions or disappear. Not only are ducks strong lovers of their home locality but they are often prevented from taking up new quarters by the concentration of the numbers of their kind elsewhere. Hence it seems reasonable to believe that when nesting grounds are destroyed, and the ducks do not adapt themselves to new conditions, the numbers must certainly decrease. If this be true the need of furnishing safe breeding places for native ducks is imperative.

The Los Baños country is conceded to embrace the best of the breeding grounds of central California. It seems, therefore, that some measures might well be taken to prevent the destruction of nests above noted. A more careful regulation of the water during the height of the breeding season would interfere very little with the pasturage and would save many ducks. The encouragement of trapping might reduce the predaceous animals to such an extent that their depredations would be of little importance. The present prices on skins of fur-bearing animals is sufficient to pay for their capture. Even the hiring of one man to supervise this particular district during the breeding season would doubtless bring excellent returns. He could trap predaceous animals himself, could interest others in doing the same at the proper season, and could no doubt find means of reducing the destruction consequent upon the rise and fall of the water.

Obviously any methods which can be applied during the nesting season and which will insure a greater percentage of successes in rearing young will add just that much more to the annual yield. The visit to the Klamath Lake Bird Reservation clearly demonstrated that it is possible to maintain safe breeding places. I should say that the ducks in this vicinity were at least 75 per cent more successful than those at Los Baños. One of the first things noted on the preserve was the fearlessness of the birds. A person could easily approach within a few yards of them. As the government allows trappers to catch fur-bearing mammals on the Reservation these enemies are kept down to a minimum. Conditions are as near the natural as can be imagined, and the birds apparently profit immensely by this circumstance.

As an object of sport the duck has a value in dollars and cents. By the time the gun-club man pays for his trip, ammunition, entertainment, etc., he usually pays more than two dollars apiece for the ducks he shoots. Add to this value the pleasure the wild duck affords the man who does not shoot and it will be readily seen that a valuation of two dollars a head is not too high. As wild game belongs to the people as a whole, such a valuation emphasizes the importance of the state and federal government taking just as active interest in preserving this as any other natural resource such as forests or water supply. There is no reason why the mature crop of ducks should not be harvested yearly, just as the mature crop of timber is harvested. The same rational view as is accorded the administration of other national resources needs to be applied here. Supervision of natural nesting grounds and even a considerable expenditure of money to secure and maintain additional breeding grounds as game refuges would, therefore, seem to be justified. More study in this direction will doubtless suggest other means by which our supply of native ducks can be increased.

One virtue of the gun club which in a measure offsets excessive shooting

during the open season is that it provides safe breeding grounds for many ducks. Much of the land owned by gun clubs would now be reclaimed and under cultivation had it not been appropriated for private game preserves. It is probable that most of our home birds are reared on the same grounds where they are later shot. This being true, it is incumbent upon the sportsmen of the state and others who shoot to see that excessive hunting does not reduce the supply of native ducks to the danger point. The necessary stock of breeding birds is even more important than available breeding grounds.

The continued reclamation of marsh lands is undoubtedly reducing the available nesting grounds. Nor is there hope that the swamping of land for pasturing cattle, or the forming of reservoirs for the storage of water will keep pace with the destruction of breeding grounds. Shooting during the open season is also yet too severe to allow of maintaining the proper breeding stock of native birds, and only a smaller bag limit will remedy this adverse feature. It is, therefore, imperative that steps be taken to not only provide suitable nesting grounds to take the place of those used up for agricultural purposes but also to cut down the annual toll enough so that we may maintain our native duck supply at a maximum productivity.

*Berkeley, California, July 31, 1914.*

## A METHOD OF CLEANING SKULLS AND DISARTICULATED SKELETONS

By F. HARVEY HOLDEN

(Contribution from the University of California Museum of Vertebrate Zoology)

**A**LTHOUGH skins of birds and mammals have been preserved by museums and private collectors for many years, the saving of complete skeletons has, to a large extent, been neglected. Anyone engaged in intensive scientific research will realize that it is almost impossible to find representative skeletons in even the larger museums, while the private collector seldom if ever saves this part of his specimens which might prove invaluable if made available for study. Indeed, comprehensive osteological research on recent forms is, except in rare instances, impossible.

It requires no argument to show that this is a deplorable condition. The vertebrate paleontologist is, of necessity, an osteologist; yet his work is curtailed at every point because of the lack of descriptions of Recent material or access to such material itself. In taxonomic studies, also, many questions are unsettled upon which the study of the skeleton would throw important light.

One of the chief reasons for the lack of complete collections of skeletons of existing animals,—as complete as such collections might reasonably be expected to be,—is that it has been found both unpleasant and laborious to prepare the bones in shape for comparison or study. Either maceration has been employed, or the bones have been boiled in a solution of lye; the former requires several months for completion, while the latter process is injurious to the bones, and to the hands of the operator. It is hoped that once the greater part of the unpleasantness and labor has been eliminated, the study of osteology will take the place it should among other branches of zoology.