

COLONIZATION OF THE BROWN BOOBY AT THE CORONADO ISLANDS, BAJA CALIFORNIA, MEXICO

DARRELL L. WHITWORTH, HARRY R. CARTER, and JOSH S. KOEPKE, California Institute of Environmental Studies, 3408 Whaler Avenue, Davis, California 95616 (Carter's contact address: Carter Biological Consulting, 1015 Hampshire Road, Victoria, British Columbia V8S 4S8, Canada); darrellwhitworth@vodafone.it
RICHARD J. YOUNG, Department of Wildlife, Humboldt State University, Arcata, California 95521

ABSTRACT: In 2005, we documented the colonization of Middle Rock, Coronado Islands, Baja California, Mexico by the Brown Booby (*Sula leucogaster brewsteri*)—a significant northern extension of the species' breeding range possibly related to warming trends in the northeastern Pacific Ocean. Confirmed nesting in 2005 was preceded by an increase in sightings at sea along the northwest coast of Baja California and California in the 1990s and early 2000s and attendance at Middle Rock since at least 2002. In 2002, we observed Brown Boobies on Middle Rock in incubation postures attending two Western Gull (*Larus occidentalis*) nests containing one gull egg each. One of these gull nests was attended for at least 33 days at the exact site where a single Brown Booby nest was confirmed each year from 2005 to 2007. In 2005 the nest successfully fledged a chick but in 2006 failed for unknown reasons. In 2007, two nests fledged single chicks. Excluding juveniles, documented attendance of at least 6 boobies in 2002, 7 in 2006, 12 in 2006, and 35 in 2007 suggests that the colony will grow further.

The Brown Booby (*Sula leucogaster*) has a pantropical distribution with multiple subspecies, including *S. l. brewsteri*, which breeds on islands in the eastern tropical Pacific from the northern Gulf of California south along the Pacific coast of Mexico, including the Revillagigedo Islands (Bent 1922, Howell and Webb 1995, Schreiber and Norton 2002). Before 2005 no breeding had been noted at the Coronado Islands or elsewhere along the Pacific coast of Baja California. In this article we describe our observations of Brown Boobies at the Coronado Islands from 2002 to 2007, briefly discuss this range expansion in the northeastern Pacific Ocean, and attempt to explain unusual nesting behaviors in 2002.

STUDY SITE AND METHODS

We recorded Brown Boobies incidentally during studies of Xantus's Murrelet (*Synthliboramphus hypoleucus*) and other breeding seabirds at the Coronado Islands (32° 25' N, 117° 15' W; hereafter "Coronados") April–June 2002, March–November 2005, April–July 2006, and March–July 2007 (Hamilton et al. 2006, Whitworth and Carter unpubl. data). The Coronados lie near the United States–Mexico border, approximately 11 km west of Tijuana, Mexico, and 24 km southwest of San Diego, California (Figure 1). We observed Brown Boobies only on Middle Rock, the smallest and lowest (maximum elevation 30 m) of the four Coronado Islands. The breeding seabird fauna of the Coronados comprises the Black (*Oceanodroma melania*), Leach's (*O. leucorhoa*), and Ashy (*O. homochroa*) Storm-Petrels,

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Figure 1. Location of the Coronado Islands off the northwest coast of Baja California, Mexico, in relation to principal breeding colonies (marked with asterisks) of the Brown Booby in northwestern Mexico.

Brown Pelican (*Pelecanus occidentalis*), Double-crested (*Phalacrocorax auritus*), Brandt's (*P. penicillatus*), and Pelagic (*P. pelagicus*) Cormorants, Western Gull (*Larus occidentalis*), Xantus's Murrelet, and Cassin's Auklet (*Ptychoramphus aleuticus*) (Everett and Anderson 1991). Middle Rock annually hosts small colonies of the murrelets, gull, and Black and Ashy Storm-Petrels, and in some years also hosts small colonies of the pelican and Brandt's and Pelagic Cormorants.

We visited the Coronados once per month in 2002 and every two to four weeks in 2005, 2006, and 2007, with each visit lasting one to four days. During each trip, we landed on Middle Rock for at least one hour. We inspected booby nests (briefly flushing adults) on a few occasions to establish contents and take photographs.

We referred to Harrison (1983) for aging and sexing Brown Boobies. We distinguished adult males from adult females by their white head, characteristic (in varying degrees) of all eastern Pacific subspecies of the Brown Booby.

RESULTS

2002 Observations

On 6 April, we first observed six Brown Boobies (three males, two females, and one subadult), roosting on a steep slope about 15 m above the landing point on the east shore of Middle Rock. Most of them spent the morning

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and early afternoon roosting on this slope; we noted no obvious nests or breeding behaviors. Western Gulls were also on Middle Rock on this day, but we found no nests. On 17 May, on the same slope where we saw the birds roosting in April, we noted several boobies, including one male and one female, in incubating posture on two gull nests about 4 m apart and 3–4 m above the ledges where the other boobies were roosting (Figure 2). Both individuals flushed during our efforts to photograph the nests from above, revealing a single Western Gull egg in each nest (Figures 2 and 3). Western Gull and Brown Booby eggs are of similar size but colored differently: Brown Booby eggs have a uniform pale shell coated with a dull white chalky deposit (Figure 4), whereas Western Gull eggs are heavily mottled on a dark olive-brownish background (Figure 2). Each nest consisted of a scrape lined with dry vegetation, although one nest (A) contained more vegetation and appeared more intact than the other (B; Figure 3). The female returned to nest A soon after we left and resumed an incubation posture, while a male returned to nest B but did not immediately resume an incubation posture. Since boobies incubate eggs with their feet (Nelson 1978), we could not determine if the attending boobies were attempting to incubate the gull eggs. We did not see boobies standing above the eggs to cool them, as done during incubation in warmer climates. Later that day, a male took over attending nest A, also assuming an incubation posture. An “incubating pair” was also observed at the same location on 18 May (R. A. Erickson pers. comm.). On



Figure 2. Adult female Brown Booby in incubation posture on Western Gull nest A at Middle Rock, Coronado Islands, 17 May 2002. Inset: Western Gull egg in nest.

Photos by Darrell L. Whitworth



Figure 3. Two Western Gull nests attended by Brown Boobies at Middle Rock, Coronado Islands, 17 May 2002 (nest B foreground; nest A background).

Photo by Darrell L. Whitworth

19 June, our last survey in 2002, several Brown Boobies were again roosting on the same slope, and a female was again observed in incubation posture at nest A. There were no birds at or near nest B, where the egg and most nest material were gone. We inspected nest A, but the egg did not appear to be viable—its contents appeared to be liquid when the egg was rolled in the hand. The pair of boobies was strongly attached to nest A, allowing us to approach within 1 m of the nest before flushing and circling to within a few meters of the site while we were present.

2005 Observations

On 23 and 24 March, we observed an adult female Brown Booby incubating a two-egg clutch of Brown Booby eggs (Figure 4), with an attending male standing nearby, in the exact location of nest A in 2002. Another four boobies (two males, one female and one subadult) were roosting in the shade on lower ledges. There was no evidence of activity at nest B. On 4 April, a female was in incubation posture at nest A, but we did not view the nest's

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Figure 4. Two-egg clutch in Brown Booby nest A on Middle Rock, Coronado Islands, 24 March 2005.

Photo by Darrell L. Whitworth

contents. On 18 April, a single small to medium-sized downy chick was in the nest and being brooded by an adult male (Figure 5A), but the second egg or chick was missing. Fratricide is common in the Sulidae (Nelson 1978), and we suspect that the second egg hatched and the younger chick was ejected by the older sibling and killed or scavenged by Western Gulls. On the basis of the chick's size and an incubation period of 42–47 days (Dorward 1962, Nelson 1978, Schreiber and Norton 2002), the egg was likely laid in early February and hatched in late March. On 16 May, a female was attending a large downy chick at nest A, but most nest material had disappeared (Figure 5B). By 19 June, the chick had acquired juvenal plumage but some down still adhered to its head. Boobies continued roosting on Middle Rock subsequently, with the high count for 2005 of seven birds (four males, two females, and one subadult, excluding the juvenile) on 19 September. Six birds were still present on 19 October, our last survey in 2005.

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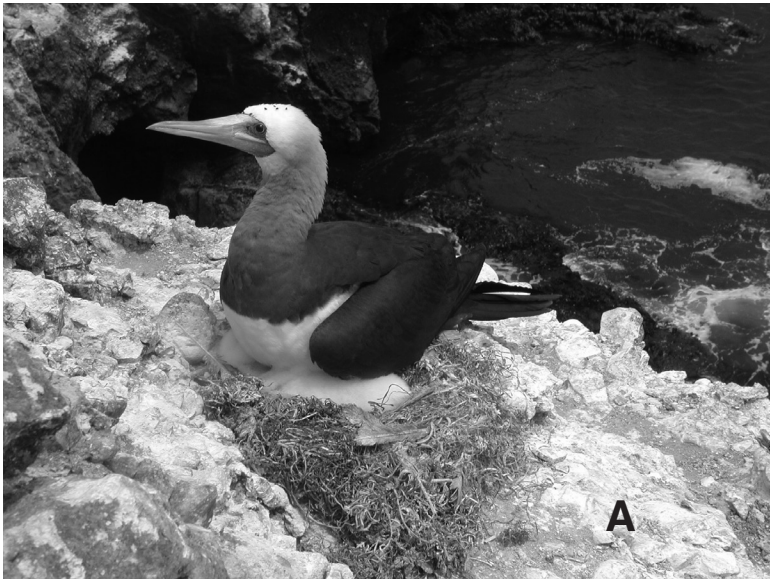


Figure 5. Downy Brown Booby chick in nest A at Middle Rock, Coronado Islands, in 2005: (A) adult male brooding chick on 18 April; and (B) adult female attending chick on 16 May, with nest material missing.

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2006 Observations

On 11 and 12 February, when as many as seven Brown Boobies were around the island, a pair was rebuilding nest A, (M. J. Billings and G. McCaskie pers. comm.). On 23 April, an incubating female and attending male were at nest A, and eight other birds (three males, three females, and two subadults) were roosting on the ledges below. On 24 April, we briefly flushed the female and found one egg. On 7 May, a female was observed in incubation posture on nest A and six other roosting birds (three adult males, one subadult male, and two other subadults) were nearby. On 22 May, a female was again observed in incubation posture on nest A with three other birds roosting on lower ledges nearby. On 5 June, eight individuals were roosting near nest A, but the nest materials had disappeared and no boobies were attending the site. We found no broken eggs or dead chicks nearby, although there was an empty gull nest (not at nest B) upslope. Although we could not determine if or when hatching occurred at nest A, observations suggest incubation lasted at least 29 days. The egg may have been laid about 23 April when one egg was seen or, if only one egg was laid, this egg may have been laid earlier in April. Thus the egg may have hatched before the nest failed. On 19 June, we recorded the high count for 2006 of 12 boobies (four males, four subadult males, three females, and one subadult or adult female), eight on the shaded lower ledges below the nest and four on shaded ledges about 50 m north on the east side of Middle Rock. A standing pair (adult male and adult female) of boobies passed a feather back and forth, a reported courtship behavior (Nelson 1978). On 23 July, our last survey in 2006, we noted 10 boobies.

2007 Observations

On 25 March, two nests were attended by females in incubation postures: nest A (same location as used in 2002, 2005, and 2006) and nest C (located farther downslope within a hollowed grotto below and to the right of the lower roosting ledge). Nest C was within 5 m of a path we used to reach our plots for monitoring murrelets. Twenty-nine boobies were present, including 10 females, 8 males, and 11 subadults. We observed one billing male–female pair and one allopreening male–male pair, but no nest or nesting material was evident nearby. In addition, one adult Blue-footed Booby (*Sula nebouxii*) was roosting in association with the Brown Boobies (Figure 6). On 29 April, a medium-sized downy chick was visible at nest C but an adult in incubation posture was noted at nest A. On 13 May, both nests had downy chicks but the chick in nest C was close to adult size with some flight feathers visible, whereas the chick in nest A was all downy. The egg in nest C was apparently laid in mid February and hatched in early April, while the egg in nest A was apparently laid in mid to late March and hatched in early May. On 26 May, we counted a total of 25 boobies. The chick in nest C had grown most of its juvenal plumage but had some down remaining on the wings, neck, and legs and was still attended by a pair of adults. The chick in nest A was still mostly downy and was brooded by the adult female. On 24 June, we recorded the high count for 2007 of 35 Brown Boobies (27 adults, 8 subadults) and one adult Blue-footed Booby (roosting with the Brown Boobies). The chick at

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Figure 6. Adult Blue-footed Booby roosting at Middle Rock, Coronado Islands, 25 March 2007.

Photo by Ian Austin

nest C was fully feathered but still had a small amount of down on the back. This chick was roosting with an attending adult female on rocks below the nest site and did not fly or move away when we approached within 1 to 2 meters, although the female departed. This chick and attending adults did not react when we used the path near the nest during earlier trips in 2007. The chick at nest A also was fully feathered (but with some down on the head) and was attended by a pair of adults passing a stick back and forth near the nest site. On 21 July, our last survey in 2007, about 30 Brown Boobies were present, including both juveniles, but the nest sites were not attended and no nest materials were evident.

DISCUSSION

The Brown Booby's breeding at the Coronados represents a considerable northern extension of its breeding range in the northeast Pacific Ocean. Like other subspecies of the Brown Booby, *S. l. brewsteri* has tropical and subtropical affinities, and recent warming trends in ocean waters may have

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assisted the northward extension of its breeding range. Warming of the northeastern Pacific has been associated with changes in species composition and abundance of plankton, fish, and seabirds in the California Current (Roemmich and McGowan 1995, Veit et al. 1996, Field et al. 2006). Changes in the distributions and breeding ranges of marine birds might be one consequence of ocean warming related to global climate change (Crick 2004). Brown Boobies have not yet colonized other suitable islands along the Baja California coast, however, suggesting that breeding at the Coronados might instead be an anomalous response to locally abundant prey and low levels of human disturbance at suitable nesting habitats. Future observations may assist interpretation of why the Brown Booby first colonized the Coronados rather than other potential nesting sites farther south along the Pacific coast of Baja California. We note that since 2002 South Coronado Island has been the site of a relatively large tuna farm, which may have contributed in some way to this colonization, but otherwise no major changes have occurred at Middle Rock in the last decade.

The Brown Booby colony nearest the Coronados is in the northern Gulf of California at Consag Rock, over 300 km away across the mountainous northern section of the Baja California peninsula (Figure 1; Bancroft 1927, Schreiber and Norton 2002). Farther south, colonies of *S. l. brewsteri* lie at least 1400 km away in the offshore Revillagigedo Archipelago, the southern Gulf of California, and off the Mexican states of Nayarit and Guerrero (Everett and Anderson 1991, Howell and Webb 1995, Pitman and Ballance 2002, Schreiber and Norton 2002).

Until the 1990s, Brown Boobies were seldom seen along the west coast of Baja California. They were not observed during visits to the Coronados in the early 20th century (Grinnell and Daggett 1903, Osburn 1909, Wright 1909, Howell 1910, Stephens 1921) or other western Baja California islands (Kaeding 1905, Willett 1913, Wright 1913, van Denburgh 1924, Lamb 1927). Prior to 1950 they were observed off the west coast of Baja California very infrequently (Huey 1924, 1935; van Rossem 1945). At the Coronados, Jehl (1977) listed the Brown Booby as accidental in the 1970s, and it was not observed during several trips to the islands 1977–79, 1986–89, and 1996–98 (D. W. Povey in litt.) or at Middle Rock 1989–91 (W. T. Everett pers. comm.).

Breeding at the Coronados was preceded by a marked increase in frequency of northern sightings. In the 1980s, Brown Boobies began to be seen more frequently off California, with annual sightings since 1990 and an injured nearly adult male recovered on the beach at Imperial Beach, 20 km northeast of the Coronados, 2 April 1990 (San Diego Natural History Museum 46566, California Bird Records Committee 2007). Several sightings were made in northwestern Baja California prior to 2002, including at the Coronados in 1999 and 2001 and at the Todos Santos Islands in 1993, 2000, and 2001 (Palacios and Mellink 2000; R. A. Erickson unpubl. data). In addition to our observations in 2002, F. Gress and E. Palacios (unpubl. data) saw Brown Boobies on Middle Rock repeatedly in spring from 2002 to 2004 but noted no nests. Breeding at nest A from 2005 to 2007 likely indicated strong attachment to this exact site and territory 2002–04. Furthermore, the presence of subadult boobies on Middle Rock from 2005 to

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2007 suggests that successful but undocumented breeding may have taken place in 2003 and 2004.

In 2002, prolonged "roosting" (at least 33 days) on usurped or adopted gull nests may have represented either territorial behavior by nonbreeding adults that stimulated or contributed to development of breeding behavior in subsequent years or undocumented unsuccessful nesting by breeding adults in 2002 with subsequent adoption or usurping of nearby gull nests. In seabirds adoption of eggs or nests is uncommon within a species and even more rare between species (Carter and Spear 1986, Hébert 1988, Gaston et al. 1993). "Reproductive errors" (Plissner and Gowaty 1988), however, have sometimes been noted after the loss of a nest or brood. Parental instincts are strong innate behaviors that sometimes can be directed toward inappropriate subjects, and such "misplaced" reproductive behaviors have been noted in the Sulidae previously. Brown and Blue-footed Boobies have been observed incubating large pebbles and small rocks at colonies in the Gulf of California (Mellink 2002). Bent (1922) reported Masked Boobies incubating "large sea shells which in shape and size somewhat resembled their eggs" and tending for prolonged periods sea shells placed in nests as surrogates for collected eggs. Incubation of foreign egg-shaped objects or "pseudo-eggs" in the Laridae and Sulidae is thought to result from behaviors intended to retrieve displaced eggs (Conover 1985, Mellink 2002).

Brown Boobies lay eggs on the bare ground but often line nest edges with sticks, vegetation, and rocks to prevent eggs from rolling out of nests (Bent 1922). At the Coronados, the nest materials and structures varied considerably each year (Figures 2 and 3), but substantial nest structures were evident each year. While gulls apparently built the nests in 2002, boobies built extensive nests in 2005, 2006, and 2007, using quite varied nest materials with much seaweed. Nest materials also disappeared during the breeding season in 2005, 2006, and 2007, indicating that nests were rebuilt each year.

Successful fledging of chicks plus increasing numbers of adults and subadults attending Middle Rock from 2005 to 2007 suggests that this colonization by Brown Boobies will lead to greater numbers of nesting birds and development of a long-term breeding colony in the future. Colony attendance without breeding by a Cory's Shearwater (*Calonectris diomedea*) from 2005 to 2007 (Hamilton et al. 2006, Carter and Whitworth unpubl. data) and a Blue-footed Booby in 2007 also may signal increased future use of the Coronado Islands by other seabird species.

ACKNOWLEDGMENTS

In 2002, funding and administrative support for seabird studies by Carter, Whitworth, and Young at the Coronado Islands were provided by Humboldt State University and the U.S. Geological Survey, with assistance from Richard Golightly, Dennis Orthmeyer, and John Takekawa. Research permits were provided by Eduardo Palacios (Centro de Investigación Científica y de Educación Superior de Ensenada). We appreciated field assistance by Daisy Burns, Eileen Creel, Laurie Harvey, John Mason, and Bill McIver, as well as support from the charter vessel *Instinct* and owner/skipper Dan Christy. In 2005, 2006, and 2007, funding and administrative support for seabird studies by Carter, Whitworth, and Koepke at the Coronado Islands was provided by

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the California Institute of Environmental Studies, ChevronTexaco de México, Dames & Moore de México, the Algalita Marine Research Foundation, and URS Corporation, with assistance from Franklin Gress, Greg Minnery, Bill Graessley, Eugenia Sangines, and Ian Austin. Research permits were provided by Eduardo Palacios. We appreciated field assistance by Ian Austin, Ross Carter, Lyann Comrack, Richard A. Erickson, Marcus Eriksen, Doug Fink, Franklin Gress, Christine Hamilton, Laurie Harvey, Percy Hébert, Nate Jones, Wendy Kozlowski, Bill McIver, Sheridan Merritt, Greg Minnery, Scott Newman, Eduardo Palacios, Christine Rothenbach, Elizabeth Swick, Amy Whitesides, and Andrea Whitworth, as well as support from the chartered ORV *Alguita* (Algalita Marine Research Foundation), owner/skipper Charles Moore, and several assistants. Valuable information on Brown Boobies and the Coronado Islands was provided by Richard A. Erickson, William T. Everett, Franklin Gress, and Eduardo Palacios. Valuable comments were provided by Richard A. Erickson, Steve N. G. Howell, Robert Langstroth, and Robert L. Pitman.

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Accepted 7 September 2007