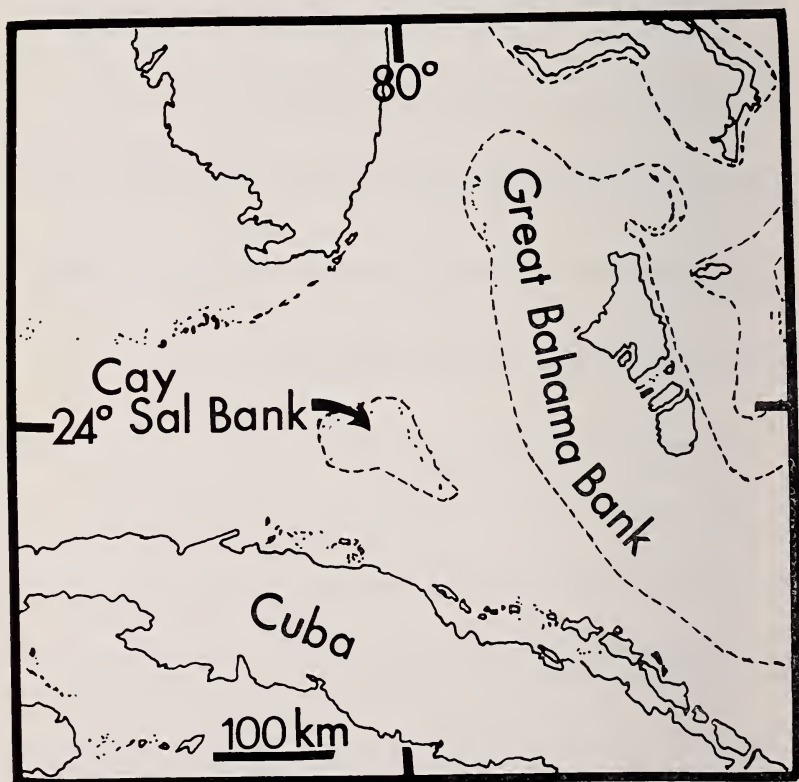


Reptiles and Birds of the Cay Sal Bank, Bahama Islands

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PROBABLY the least known faunistically of the Bahama Islands, and even of the entire Antillean region itself, is the Cay Sal Bank, whose scattered islands lie on the periphery of the 85 kilometer-wide bank, about 160 kilometers south-southeast of Florida and 85 kilometers north of Las Villas Province, Cuba. The edge of Great Bahama Bank lies about 100 kilometers east of the Cay Sal Bank, but the nearest adjacent Bahama island on the Great Bank is Andros, some 180 kilometers to the east (Fig. 1). Although politically and geologically (as a portion of the Cuban foreland) part of the Bahama Islands, the Cay Sal Bank is far removed from the main mass of the Bahamian archipelago and in actuality lies much closer



to the northern Cuban coast than it does to the balance of the Bahamas. The intermediate position of the Cay Sal Bank, between Cuba, continental Florida, and the Bahama Islands, makes it a potentially most interesting area as far as its fauna is concerned.

Few collectors have visited the Cay Sal Bank; this is doubtless due to its remote position and the fact that the islands are all relatively small and widely scattered along the edges of the bank itself. The only herpetological collections made in this region are those of Paul Bartsch, who, as an adjunct to his malacological material, secured a very few specimens of two species of lizards and one snake on a visit to four cays (Elbow Cay, Cay Sal, Cotton Cay of the Anguilla Cays, Double Headed Shot Cay) in 1930. The Bartsch collection was reported upon by Cochran (1934). Bird collections were made earlier by Cyrus S. Winch in 1891 and J. S. Solomon in 1901. These collections were reported upon by Cory (1891) and Bonhote (1903). The position of the Cay Sal Bank between the Antilles and the continent makes it a most interesting site for observation of migrants; the previously reported resident birds have been very few, and indeed the status of some previously reported residents has apparently changed since those reports were written.

In an effort to secure additional herpetological material from the Cay Sal Bank, Richard Thomas made two visits to the area. On one occasion he spent a day (16 March 1967) ashore on Elbow Cay at the northwestern corner of the Cay Sal arc, and on the other he collected for a small portion of a day (14 June 1967) on the Anguilla Cays at the southeastern extreme of the arc; his activities at the latter locality were curtailed by extremely bad weather. Despite his brief stays on these islands, Thomas was able to add two species of reptiles to the Cay Sal Bank fauna and to augment previous collections of another species. The senior author spent a week on Cay Sal itself but found it extremely poor herpetologically, with but two species of lizards present. However, the time of his visit (18-24 April 1968) was a very propitious one for bird observation, and he was able to increase considerably the number of both migrants and residents recorded for the Cay Sal Bank. The present paper summarizes our knowledge of the herpeto- and avifaunas of the Cay Sal Bank, based primarily upon collections made by the senior author and Richard Thomas.

Cay Sal, approximately 3 kilometers long and 2 kilometers wide,

represents one of the largest islands on the Cay Sal Bank. It is situated at the extreme southwestern portion of the bank about 65 kilometers off the northwest coast of Cuba across Nicholas Channel.

Though small in size, Cay Sal has several distinctive habitats. The entire island is circumscribed by a smooth white sandy beach, the upper zone of which supports a heavy growth of strand vegetation as well as several kinds of shrubs and bushes. At the southern end of the island this zone is characterized by a rather extensive growth of sea-oats (*Uniola*). Shrubs and bushes become increasingly more numerous toward the interior, eventually grading into palm scrub.

Palm trees are for the most part scattered throughout the interior and do not form any pure stands. They are 5 to 7 meters in height and their trunks, which are one to several decimeters in diameter, form favored resting sites for anoline lizards. Dispersed among the palm trees are a diminutive species of palm, one to two meters in height, and several species of shrubs, the latter at times becoming so dense as to form a nearly impenetrable mass of vegetation.

Much of the southern portion of the island is occupied by a shallow mangrove-fringed lagoon, connected to the sea via a relatively short and narrow channel which forms a break on the west shore. The channel is easily traversed on foot at low tide, and the periodically exposed sand bars at the mouth of the lagoon play host to a variety of shore birds.

The north end of Cay Sal is bisected by an airstrip which extends from the beach area to the northern fringe of the lagoon. Southwest of the airstrip and adjacent to the west shore are the living quarters for the island's several inhabitants. Much of this area is now barren as a result of the clearing of the natural vegetation; grasses and small herbaceous plants predominate. Coconut trees have been planted adjacent to the buildings.

Cay Sal is generally of low relief with the highest elevations along the east shore where the land rises abruptly from the beach (13-17 meters), thence grades slowly downward toward the south and west. A lesser ridge occurs along the northwest shore. Along the lower interior slope of the latter there is a dense entanglement of vines and deciduous trees.

The substrate is predominantly fine loose sand, with mud in association with the mangrove community. Several basin-like areas were found on the island. These were extremely parched during the senior author's visit, but such areas may form transient pools of fresh water following periods of heavy rain.

Thomas (pers. comm.) described Elbow Cay, in the northwest portion of the bank, as being "almost solid limestone with sandy soil for the most part in rather circumscribed solution holes. Vegetation is low and sparse, and from a short distance offshore the island looks like bare rock. There is a dense but circumscribed patch of *Opuntia*, a couple of meagre *Cocos nucifera* and a couple of equally meagre *Casuarinas*. Adjacent islets are smaller, narrower, but of similar appearance." An unmanned (and in all probability non-functional) lighthouse is also on the island. This is assumed to be the "Cay Sal Light" referred to by Bonhote (1903). Elbow Cay is steep-sided and fairly high (10 to 13 meters).

That portion of the Anguilla Cays (southeast section of the bank) visited by Thomas "was lower [than Elbow Cay], less pronouncedly rocky (*i.e.*, with greater exposure of sand in places), and with more diverse low scrubby vegetation, including . . . a thatch palm, *Coccoloba*, and various other woody shrubs."

We wish to acknowledge the assistance of Richard Thomas in the preparation of the present paper and to recognize as well the cooperation extended him by Frederick M. Berry and the staff of the Tropical Atlantic Biological Laboratories of the United States Bureau of Fisheries in allowing him to travel aboard the R/V *Undaunted* on two occasions. The senior author visited Cay Sal through the efforts of Stephen M. Hurst and the cooperation of C. W. Moody of Miami, Florida, who presently owns Cay Sal. Without the very great assistance of the resident commissioner, Harcourt Thomas, and the few residents on Cay Sal, the senior author's stay there would have been far less pleasant and profitable than it was. All material reported upon is in the collection of the authors; we wish to thank Lewis D. Ober for the opportunity to study comparative material in his collection, William B. Robertson for assistance with bird literature in reference to the Cay Sal Bank, and James Bond for information on several species reported from these islands.

REPTILES

Sphaerodactylus decoratus flavicaudus Barbour

At the time of their revision of the *S. decoratus* complex in the Antilles, Thomas and Schwartz (1966) had no specimens of this species from the Cay Sal Bank. Thomas collected a series of 25 specimens on Elbow Cay where these geckos were extremely abundant under rocks. The series consists of five unpatterned males and 20 females and female-patterned subadults and juveniles. The dark body bands are either 3 or 4, with the latter number the more common. The males had yellow heads and tails and lacked spotting. We have no hesitancy in assigning these lizards to *S. d. flavicaudus* since they agree very well with the redefinition of that form as given by Thomas and Schwartz (1966, pp. 7-8).

S. d. flavicaudus is now known to occur on the Cay Sal Bank, Andros, and South Bimini (but the species is absent from North Bimini). The association of the Cay Sal Bank and Bimini (as in the case of *Tropidophis canus*; see beyond) suggests that Bimini may have been secondarily invaded by *S. decoratus* by Gulf Stream transport from the Cay Sal Bank. The occurrence of the same subspecies on Andros, however, may indicate that the Bimini population has been derived from that island rather than from Cay Sal; certainly the proximity of Andros to Bimini in contrast to the distance between Cay Sal and Bimini would suggest that Andros has been the site of origin for the Bimini lizards. It is also possible, of course, that Cay Sal *decoratus* colonized Andros and thence reached Bimini from the latter island. This explanation has more to recommend it, for there seems to be little opportunity for Andros-to-Cay Sal natural transport. Considering the absence of *S. decoratus* on the Anguilla Cays and, most especially, on Cay Sal itself, another possibility is that the species has reached Elbow Cay through accidental human introduction. Thomas (1968) has recently reported the occurrence of this gecko on Elbow Cay.

Anolis carolinensis fairchildi Barbour and Shreve

Cochran (1934, p. 15) first reported "*Anolis brunneus*" from Cay Sal and Cotton Cay on the Cay Sal Bank; the five specimens

recorded were taken by Bartsch. Later, Barbour and Shreve (1935, p. 357), using these same specimens, named *Anolis fairchildi* from Cay Sal; these authors regarded *fairchildi* as related to *A. porcatius* Gray from Cuba and *A. smaragdinus* Barbour and Shreve from the Great Bahama Bank. Oliver (1948, p. 7 et seq.), in his description of *A. carolinensis lernerii* from the Bimini Islands, considered that *fairchildi*, *smaragdinus*, and *porcatius* (as well as *brunneus*) should all be considered subspecies of continental *A. carolinensis* Voigt. Ruibal and Williams (1961) showed that the Cuban "*A. porcatius*" was in actuality a composite of two species, one of which is *A. allisoni* Barbour; the other species they considered as a distinctive form (as *A. porcatius*) although they stated that their use of a binomial was a matter of convenience since obviously Cuban *A. porcatius* showed variation comparable to that of already named Bahamian subspecies. We agree completely with their comments but feel that until such variation on Cuba is studied in detail, it is appropriate, in order to demonstrate its affinities with the balance of the *carolinensis* group on North America and the Bahamas, to consider *porcatius* (*sensu lato*, and including all Cuban populations presently assigned to that taxon) a subspecies of *A. carolinensis*.

A. c. fairchildi has been known from only the original five specimens. The senior author collected a series of 30 (all male) *fairchildi* on Cay Sal, but it was not encountered by Thomas on Elbow Cay nor the Anguilla Cays; the latter is remarkable since the lizard is known from Cotton Cay, one of the Anguilla Cays. In an effort to determine in what ways *fairchildi* differs from adjacent related members of the *carolinensis* group, we have taken scale counts on 20 topotypical *A. c. smaragdinus* from Long Island, 24 *A. c. carolinensis* from southern Florida and the Florida Keys, and six *A. c. porcatius* from west central Cuba.

Barbour and Shreve diagnosed *fairchildi* as being "Allied to *Anolis porcatius* and *Anolis smaragdinus* from which two species it differs in possessing larger dorsal and temporal scales; it differs from both also in coloration." We have taken counts of scales across the snout at the level of the first (counted from the anterior margin of the eye) canthal scales, number of rows of scales between the supraorbital semicircles, number of scales between the supraorbital semicircles and the interparietal (right and left sides of each lizard written as a fraction, as 1/1, 2/2, etc.), fourth toe la-

mellae on phalanges II and III, number of postmental scales, number of loreal scales on one side, number of temporal scales between the posterior margin of the orbit (exclusive of the posterior enlarged members of the circumorbital series), and the anterior margin of the ear opening, and have measured head length from the anterior margin of the ear opening to the snout and head width across the broadest portion of the head at the temporal region. Several of these counts have proven valuable in analysis of subspecific variation in other Antillean anoles (*A. distichus*, Schwartz, MS; *A. homolechis* complex, Schwartz, 1968b; *A. angusticeps*, Schwartz and Thomas, MS).

As far as scutellation is concerned, the subspecies *carolinensis*, *smaragdinus*, *fairchildi*, and *porcatus* seem remarkably poorly defined. Of these four taxa, *fairchildi* males reach the largest size (76 mm in snout-vent length) with *porcatus* males only a millimeter smaller (Ruibal, 1964, p. 486). The largest *smaragdinus* from Long Island has a snout-vent length of 60 mm; indeed Barbour and Shreve (1935, p. 355) partially diagnosed *smaragdinus* on its much smaller average size in comparison with *porcatus*. The largest south Florida *carolinensis* male has a snout-vent length of 56 mm; Duellman and Schwartz (1958, p. 278) reported 58 mm as the largest male from the Miami area studied by them. Of these four forms, *fairchildi* and *porcatus* males are large, and *carolinensis* and *smaragdinus* males are considerably smaller. Females seem to show the same general picture, but our recent series includes no female *fairchildi*. The largest Long Island female *smaragdinus* has a snout-vent length of 45 mm, the largest *porcatus* female has a snout-vent length of 65 mm, and the largest *carolinensis* female (Duellman and Schwartz, 1958, p. 279) 52 mm.

Scales across the snout at the first canthals are modally 5 in Long Island *smaragdinus* (mean 5.3; range 5-7) and in *fairchildi* (mean 5.1; range 3-7), but are modally 6 in *carolinensis* (mean 6.3; range 5-8); our very small series of *porcatus* has 5, 6, and 7 with equal incidence, and a mean of 6.0. Scales between the semicircles are modally 1 in all populations, with variants of 0 (semicircles in contact) and 2 occurring in each sample. Scales between the semicircles and the interparietal are modally 2/2 in all populations, with variants of 1/1 and 1/2 in all populations, and 2/3 in *carolinensis*, *smaragdinus* and *porcatus*, and 4/4 in one *porcatus*. Of the

fairchildi, 15 lizards have 2/2 scales in this position, six have 1/1 and six have 1/2.

Fourth toe lamellae in *fairchildi* vary between 17-23 (mean 19.5); these scales have lower means and extremes in *carolinensis* (mean 17.5; range 15-19) and *smaragdinus* (mean 18.9; range 17-22) and higher in *porcatus* (mean 22.6; range 22-24). The higher *porcatus* mean may be an artifact of the small sample studied, but nevertheless we assume that, because of its larger size, *porcatus* probably has a greater number of fourth toe lamellae than the two smaller forms and is thus comparable in this feature to the large *fairchildi*.

Postmental scales are modally 4 in *carolinensis* and *porcatus* and are modally 2 in *smaragdinus* and *fairchildi*. Other than 4, *carolinensis* has 3 postmentals only as a casual variant (three of 24 individuals) and all six of our Cuban *porcatus* have 4 postmentals. On the other hand, of 20 *smaragdinus*, 14 have 2 postmentals, four have 3 postmentals, and two have 4 postmentals; of 24 *fairchildi*, 12 have 2 postmentals, three have 3 postmentals, and nine have 4 postmentals.

Of the four forms, *carolinensis* has the highest mean number of loreals (19.2; range 15-25), with *porcatus* next in rank (mean 18.8; range 15-23), *fairchildi* third (mean 14.8; range 12-20), and *smaragdinus* the lowest loreal mean (13.7; range 12-17).

The large temporals of *fairchildi* were used in part to diagnose this form. Counts of temporals between the posterior margin of the orbit and the auricular opening demonstrate quite clearly the actuality of this feature: means for the four populations are 8.0 (7-9) in *fairchildi*, 8.7 (8-14) in *carolinensis*, 9.0 (8-11) in *smaragdinus*, and 10.3 (9-11) in *porcatus*.

Ratio of head width to head length (HW/HL) in male *fairchildi* (snout-vent lengths between 67-76 mm) varies between 52.0 and 65.4, with the highest ratio for the smallest lizard; the *fairchildi* HW/HL mean is 58.0. Male *carolinensis* HW/HL varies between 52.4-73.3 (mean 59.0) but the higher ratios are for small lizards with snout-vent lengths of 30 mm or less. In *smaragdinus* males, the HW/HL ranges between 49.4-57.8 (mean 54.7) and in two *porcatus* males between 52.4-57.4 (mean 54.9).

To summarize the above data, *A. c. fairchildi* is equal in size to *A. c. porcatus* and is distinctly larger than the nominate subspecies

and *A. c. smaragdinus*. In modally having 5 scales at the level of the first canthals, *fairchildi* resembles *smaragdinus* and differs from *carolinensis* (and probably *porcatus*). The modal presence of two postmentals differentiates *fairchildi* from *carolinensis* and *porcatus* but not from *smaragdinus*. *A. c. fairchildi* has a much lower mean number of loreals than *carolinensis* and *porcatus* but is similar to *smaragdinus* in this character. Of the four subspecies, *fairchildi* has the largest temporals.

It is in color and pattern that *fairchildi* differs most strikingly from the three adjacent subspecies. There are no differences in basic dewlap color, since all subspecies involved have the dewlap pinkish to pinkish purple; the depth of pigmentation may vary somewhat, but the basic hues are pinks. Barbour and Shreve (1935, pp. 357-358) stated that the coloration of *fairchildi* was "Evidently vivid green in life . . . back abundantly spotted with white, each whitish spot covering one whole dorsal scale, on the sides there are dark transverse streaks, upper sides of limbs colored similarly to the back, except that the hind limbs are spotted with light brown to form an irregularly reticulate pattern." This description, including the assumed green color in life, fits the series of males very well. There is some variation in the amount of white dorsal dotting, and there may be white dots on the upper surfaces of the hindlimbs. The tail may also have a series of fine white transverse lines on its upper face. The sides of the trunk are regularly streaked by vertical darker green bars, closely appressed to each other, and the hindlimbs are darkly reticulate.

In having dorsal white dotting, *fairchildi* differs from all of its neighbors, since *carolinensis*, *smaragdinus*, and *porcatus* lack this feature and are basically unpatterned green lizards with pink dewlaps. The supra-axillary spot is barely indicated in *fairchildi*; most often in this position there is a small darker area surrounded by a more or less complete ring of white dots, the maximum expression of the spot. At the other extreme are males which lack any indication of the spot. *A. c. smaragdinus* lacks the supra-axillary spot, and it is variously present in *porcatus* and *carolinensis*.

The origin of *A. c. fairchildi* is probably from either *porcatus* or *smaragdinus*. In size, *fairchildi* and *porcatus* are quite similar; but *fairchildi* resembles *smaragdinus* in several features of scalation. Possibly the situation is, rather than a serial arrangement of *porca-*

tus-fairchildi-smaragdinus, a bipartite one, in that both *fairchildi* and *smaragdinus* represent two divergent lines of *carolinensis*-group anoles, both derived originally from Cuban *porcatus*, each today occupying its own bank.

Anolis sagrei ordinatus Cope

Anolis sagrei is widespread throughout the Bahama Islands; the species occurs as well on the Florida Keys and elsewhere in Florida (at least the latter areas are presumed to have been colonized by human introduction of the lizards), on Cuba and the Isla de Pinos, Jamaica, Little Cayman (and Cayman Brac, if *A. luteosignifer* Garman is considered a subspecies of *A. sagrei*), on the Swan Islands, and on the Central American mainland. Several subspecies have been named; the nominate form occurs on Cuba, Isla de Pinos, Jamaica, and Little Cayman, *nelsoni* Barbour on the Swan Islands, *mayensis* Smith and Burger on the Central American mainland, *stejnegeri* Barbour on the Florida Keys, and *ordinatus* Cope in the Bahama Islands. In addition, there are two names in use by various authors for members of this complex in Cuba (in addition to *A. s. sagrei*), namely *bremeri* Barbour and *greyi* Barbour. The acceptance of several of these forms is open to discussion; no one has critically examined specimens from throughout the range of the species, although Charles M. Fugler is presently engaged in such an undertaking.

The situation with *A. sagrei* in the Bahamas is apparently fairly straightforward. *A. s. ordinatus* was described from New Providence Island on the Great Bank, and this name has been applied to all *sagrei* from the Bahamian archipelago. The species is widespread in the Bahamas, occurring on both the Little and Great banks, Cat Island, Rum Cay, San Salvador, and Crooked (but not Acklin's) Island. We have made no detailed comparison of specimens from throughout this wide range with one another, but collecting *A. sagrei* in the Bahamas convinces us that there are several noteworthy populations which differ from one another in characteristics such as size and dewlap color. As far as Cay Sal Bank lizards are concerned, the problem arises as to whether they show closer affinities with Cuban *A. s. sagrei* or Bahamian *A. s. ordinatus*. We have examined 29 *A. s. sagrei* from Pinar del Río Province,

Cuba, 28 from the Cay Sal Bank (three from Elbow Cay, seven from Anguilla Cays, 18 from Cay Sal) and 36 from New Providence, the type locality of *A. s. ordinatus*. Two comments are necessary: 1) we are aware that choice of Pinar del Río lizards need not reflect the variation of *A. s. sagrei* throughout Cuba, since the species occurs from one end of the island to the other, and 2) we have deliberately studied only New Providence *ordinatus* since that island is the type locality of *ordinatus*, rather than studying *A. sagrei* from throughout its Bahamian range. It should be understood that our comments on *A. sagrei* are based exclusively on these three samples and that these comments do not necessarily apply to other populations of the species.

Of the three samples, the Cay Sal Bank lizards are larger in both sexes: males reach a snout-vent length of 63 mm and females 46 mm (both specimens from Cay Sal). Cuban males reach a length of 51 mm, male *ordinatus* a length of 55 mm, whereas Cuban females reach a length of 38 mm and *ordinatus* females a length of 41 mm. All samples modally have 6 scales between the first canthals, and the ranges are 5-9 scales on the Cay Sal Bank and in *ordinatus*, and 5-7 scales in Cuban *sagrei*. There is a tendency for New Providence lizards to have a higher mean number of snout scales (6.7) than Cay Sal lizards (6.3) or Cuban *sagrei* (5.9). Cuban *sagrei* modally have 1 scale between the supraocular semicircles (26 of 28 lizards), whereas Cay Sal *sagrei* modally have the semicircles in contact (16 of 26 specimens, with nine lizards having 1 scale between the semicircles and one having 2 scales). New Providence *ordinatus* also have the semicircles in contact (19 of 34 specimens; 15 lizards have 1 scale between the semicircles).

All samples modally have 2/2 scales between the semicircles and the interparietal; this modality is highest in Cay Sal specimens (67 per cent) and lowest in *ordinatus* from New Providence (42 per cent). Fourth toe lamellae average 17.6 in Cuban *sagrei*, 17.8 in *ordinatus*, and 18.1 in Cay Sal *sagrei*, with modes of 17 in the first two samples and 19 in the latter.

Cay Sal specimens have the lowest mean number (2.8) of postmentals, with *ordinatus* only slightly higher (3.0) and Cuban *sagrei* at the upper extreme (3.7). As far as loreal scales are concerned, Cuban *sagrei* have a mean of 20.9, *ordinatus* 20.6, and Cay Sal *sagrei* 22.4.

Keeling of the supracarpal scales is especially interesting. In Cuban *sagrei*, of 28 lizards, 26 were recorded as having the keeling well developed, and the remaining two had these scales weakly keeled. In New Providence *ordinatus*, 14 specimens lack keeling, 19 have the scales weakly keeled and only 2 have the supracarpals so distinctly keeled as do Cuban *sagrei*. The Cay Sal *sagrei* consist of 27 lizards with strong keeling and one with weak keeling.

In Cuban *sagrei*, the dewlap color is variable, with some populations having the dewlap mustard color and others having it orange to reddish, or yellowish, orange. In Bahamian *ordinatus*, the dewlap color by population varies from a mottled yellow and orange to orange or deep rich chocolate. The Cay Sal lizards had the dewlap orange and thus agree with both Cuban *sagrei* and *ordinatus*.

In summary, we consider the Cay Sal lizards to be closest to *Anolis s. ordinatus* rather than to Cuban *A. s. sagrei*. We base this conclusion on similarity in overall size, semicircle contact, and number of postmentals. On the other hand, Cay Sal specimens are closer to Pinar del Río lizards in number of scales between the semicircles and interparietal, and supracarpal keeling. From both adjacent populations, the Cay Sal lizards differ in fourth toe lamellae and number of loreals. It is possible that the Cay Sal Bank population of *A. sagrei* is primarily Bahamian in origin, and that there has been invasion by Cuban lizards at various times, thereby causing dilution or modification of some *ordinatus* characters. We wish to re-emphasize that study of variation throughout the total geographic range of *A. sagrei* is mandatory before any firm statements can be made about the precise affinities and origin of any isolate of that species. The wide geographic distribution and quite obvious variation of even the most superficial characteristics of *A. sagrei* indicate that analysis of the variation in the species is very greatly to be desired.

Typhlops biminiensis biminiensis Richmond

Thomas (MS) has recently reported in detail upon the series of five *T. b. biminiensis* from Elbow Cay. The specimens are identical with material from the type locality (South Bimini) and the same subspecies is presumed to occur also on Andros. The Elbow Cay

Typhlops were secured in and near the woody stems of the dominant shrub (*Tournefortia*); these stems were inhabited by termites (*Neotermes jouteli* Banks). As Thomas pointed out, the Elbow Cay series is the largest series of *T. biminiensis* to have been taken at one time; whether the species is common on Elbow Cay or whether the bleak situation on that island makes the animals easier to collect is unknown. It is remarkable that *T. biminiensis* does not occur also at least on Cay Sal, a much larger and more ecologically diversified island than Elbow Cay. We presume this peculiar distribution is due to the vagaries of overseas transport after the Cay Sal Bank had been separated into its various islets. The species *T. biminiensis* occurs on Cuba, Great Inagua, and the western Bahamas (Cay Sal Bank, South Bimini, Andros), as well as on Cayman Brac in the Cayman Islands. It is replaced by a separate but related species (*T. caymanensis* Sackett) on Grand Cayman.

Tropidophis canus curtus Garman

Cochran (1934, p. 46) first reported the occurrence of *Tropidophis* (as *T. pardalis pardalis*) from Double Headed Shot Cay of the Cay Sal group; the Bartsch collection included a single juvenile snake from this locality. Schwartz and Marsh (1960, p. 64) examined this snake and noted (as had Bailey, 1937, p. 50) that it was a typically patterned Bahamian snake rather than being like the Cuban *T. pardalis*. Since Schwartz and Marsh separated the Cuban snakes (*T. pardalis*) from their Bahamian relatives (*T. canus*), the latter name applies to this Cay Sal boid.

Two additional adult specimens were collected by Thomas on Elbow Cay. It is of interest that this snake occurs on that small islet but is absent (or at least uncollected) by the senior author on much larger Cay Sal itself. The two new snakes allow us to make some additional comments on the subspecific status of the Cay Sal snakes, but the situation is still by no means clear.

Four subspecies of *T. canus* occur in the Bahamas, to which archipelago this species is restricted. Of these, *T. c. canus* Cope is known from Great Inagua, *T. c. androsi* Stull from Andros, *T. c. barbouri* Bailey from Long Island, the Exuma Cays, Eleuthera Island and Cat Island, and *T. c. curtus* Garman from New Providence. Schwartz and Marsh (1960, pp. 62-64) commented at

length upon a series of *T. canus* from South Bimini which were indistinguishable from *T. c. curtus* and to which subspecies they tentatively assigned them, despite the interpolation of *T. c. androsi* on Andros, more or less between the two segments of *curtus*. These Bimini snakes have a distinct bearing upon the status of the Cay Sal *Tropidophis*.

The Double Headed Shot Cay specimen is a juvenile female (total length 199 mm) with 159 ventrals, 31 subcaudals, 9/9 supralabials and 11/12 infralabials, 1/1 preoculars and 3/3 postoculars, and smooth dorsal scales. There are 10 rows of blotches around the body, 66/64 paired paramedian blotches on the dorsum and 5 on the tail, and the scale row formula is 22-23-19. Of the Elbow Cay snakes, one is a male and the other a female. The former has a total length of 294 mm (tail incomplete), with 153 ventrals, 13+ subcaudals, 10/10 supralabials and 12/11 infralabials, 1/1 preoculars, 2/2 postoculars, and keeled dorsals. There are 10 rows of blotches around the body, 47/47 paired paramedian blotches on the dorsum, and the scale row formula is 23-25-19. The female is adult (total length 274 mm, tail incomplete) with 156 ventrals, 10+ subcaudals, 10/10 supralabials and 13/15 infralabials, 1/1 preoculars and 3/3 postoculars, and keeled dorsal scales. There are 10 rows of blotches around the body, 51/46 paired paramedian blotches on the dorsum, and the scale row formula is 23-23-19. All three snakes lack occipital spots (as is characteristic of the species), and all lack parietal contact (a feature which varies modally by population).

Assignment of these three snakes to any of the recognized subspecies is difficult. The subspecies *canus* can be easily eliminated (ventrals 170-182). The Cay Sal Bank snakes fall below *androsi* in ventral counts as well (153-159 in Cay Sal snakes, 157-173 in *androsi*), although there is a small amount of overlap. Geographically, it seems unlikely that the Cay Sal snakes are assignable to *barbouri*, the subspecies on the eastern half of the Great Bahama Bank (ventrals 153-165), but on the basis of ventral counts, the Cay Sal snakes could be assigned to that subspecies. However, in all features the Cay Sal snakes agree best with snakes from Bimini. Ventrals in the Bimini snakes vary between 146 and 164, body blotches are modally in 10 rows, dorsal paramedian blotches range from 40 to 90, usually the parietals are not in contact, the dorsal scales are usually keeled, and the postoculars are usually 3/3. How-

ever, the midbody scale rows are usually 25 in the Bimini boas, whereas two of three Cay Sal snakes have 23 rows at midbody.

If we consider that the Bimini boas are genetically identical with New Providence *curtus*, there is no choice but to consider the Cay Sal snakes also. Such an arrangement is even more confusing zoogeographically, since we now have a single subspecies occurring on three relatively far-flung outposts, the Cay Sal Bank, the Bimini Islands on the western margin of the western arm of the Great Bank, and on New Providence on the western margin of the eastern arm of the Great Bank. As noted above, *T. c. androsi* is interposed between the Bimini and New Providence populations of *T. c. curtus*.

At least one partial explanation suggests itself. It is possible that the Bimini boas have been established on those islands due to transport from the Cay Sal Bank via the Gulf Stream. If so, there can hardly have been any genetic community between Cay Sal-Bimini snakes on one hand and New Providence snakes on the other, unless the New Providence population has been introduced on that island through human (or barely possibly natural) means. It would be instructive in this regard to determine which subspecies of *T. canus* occurs on the string of cays between New Providence (*curtus*) and Eleuthera (*barbouri*). If these cays harbor *barbouri*, with little or no dilution by *curtus* characters, this might reaffirm the possibility that New Providence *curtus* has resulted from introduction of the subspecies on that island.

If it can be demonstrated that Cay Sal-Bimini snakes differ in some constant characters from New Providence *Tropidophis*, and this seems a very likely possibility since genetic continuity is obviously not possible at present, then the Cay Sal-Bimini snakes should be nomenclatorially set off from *T. c. curtus*. Although we apply the name *T. c. curtus* to the snakes from Cay Sal, this is surely the easiest way out of an otherwise very puzzling situation. However, there is no other choice at the present, since the Cay Sal material is extremely limited.

BIRDS

Species collected or observed for the first time on Cay Sal are either stated explicitly as being such in the following accounts, or

are implied as such when no previous records have been cited. We follow Bond's (1956) check-list in nomenclature.

Pelecanus occidentalis Linnaeus. Several Brown Pelicans of undetermined subspecies were seen daily on Cay Sal throughout the senior author's visit.

Fregata magnificens magnificens Mathews. One to several Frigate Birds were regularly observed on Cay Sal, circling overhead or harassing members of the tern populations.

Ardea herodias Linnaeus. At least two Great Blue Herons were seen frequenting the shallows of the Cay Sal lagoon. One pair was observed feeding in shallows at low tide on 20 April.

Butorides virescens virescens (Linnaeus). A single specimen taken on 21 April represents the first record of this subspecies in the Bahamas. Bond (1956, p. 12) referred to one specimen collected "off the Bahamas" with no further locality data. Green Herons were fairly common in the mangrove zone on Cay Sal. Whether these birds represented either *B. v. virescens* or the resident Bahamian *B. v. bahamensis* (Brewster), or both subspecies, is unknown.

Ardeola ibis (Linnaeus). A male in developing breeding plumage taken on 24 April furnishes the first record of this species for Cay Sal. Approximately 10-15 individuals appeared to inhabit the island, of which several were repeatedly found in the vicinity of the living quarters where they fed upon flies attracted to accumulated refuse.

Eudocimus albus (Linnaeus). A single White Ibis was observed in flight over Cay Sal on 18 April. On 19 April the bird was observed once again as it fed in the shallows on the eastern side of the lagoon.

Anas discors Linnaeus. One male Blue-winged Teal was seen on the Cay Sal lagoon on 20 April.

Pandion haliaetus carolinensis (Gmelin). One male with testes slightly enlarged was secured on Cay Sal on 21 April. The only other Osprey seen was in the company of the individual collected and was apparently also a representative of the continental subspecies and not the Bahamian resident *P. h. ridgwayi* Maynard.

Falco columbarius columbarius Linnaeus. Four Pigeon Hawks were observed on Cay Sal on 22 April, two of which were collected.

Falco sparverius Linnaeus. Richard Thomas (pers. comm.) observed at least one Sparrow Hawk on Elbow Cay on 16 March 1967, the first record of the species for the island and the bank.

Porzana carolina (Linnaeus). Although no rails were observed by the senior author, Riley (1905) listed Cay Sal as a locality for the Sora Rail.

Porphyryla martinica (Linnaeus). Bonhote (1903) recorded two Purple Gallinules taken from the Cay Sal Light on 24 April 1901 and 9 February 1902. The latter specimen struck the south side of the lantern at 2330 hours during cloudy and squally weather.

Charadrius semipalmatus Bonaparte. Several Semipalmated Plovers were observed on Cay Sal on 19 April. The species was also recorded from the island by Riley (1905).

Squatarola squatarola (Linnaeus). Black-bellied Plovers appeared fairly common along the lower Cay Sal beach. One specimen was taken on 21 April and six individuals were observed feeding together on 22 April.

Arenaria interpres morinella (Linnaeus). One Ruddy Turnstone was collected by the senior author on Cay Sal on 22 April. This species was also procured by Winch on 14-19 May 1891 (Cory, 1891).

Gallinago gallinago delicata (Ord). On 22 April a Common Snipe was flushed from the south shore of the Cay Sal lagoon.

Actitis macularia (Linnaeus). Spotted Sandpipers were frequently seen foraging among rocks and clumps of wave-washed algae along the lower beach. One individual was taken on 22 April.

Catoptrophorus semipalmatus (Gmelin). A single Willet was observed feeding in the Cay Sal lagoon on 24 April.

Calidris minutilla (Vieillot). Riley (1905) listed Cay Sal as a locality for the Least Sandpiper. None was observed by the senior author.

Calidris pusilla (Linnaeus). The Semipalmated Sandpiper has been recorded from Cay Sal by Riley (1905).

Crocethia alba (Pallas). One Sanderling was taken on Cay Sal on 22 April and several others were observed.

Larus atricilla Linnaeus. Several Laughing Gulls in breeding plumage were seen regularly near the mouth of the Cay Sal lagoon, interspersed among a large flock of terns.

Sterna fuscata Linnaeus. The occurrence of this species on Cay Sal has been recorded by Riley (1905). Bonhote (1903) also reported Sooty Terns from the Cay Sal Light and included a statement by Solomon that "these birds breed in the Cay every year when they gather by thousands from May to August." Solomon secured a single specimen on 18 April 1901. However, no Sooty Terns were observed on Cay Sal during the senior author's visit to the island. The species is also known from the Anguilla Cays through the collecting activity of Winch during May 1891 and by a notation from Riley (1905).

Sterna albifrons antillarum (Lesson). Several Least Terns were seen on Cay Sal between 18 and 24 April. Winch collected at least one specimen 14-19 May 1891 (Cory, 1891). Riley (1905) also indicated the presence of the species on the island.

Thalasseus maximus maximus (Boddaert). A flock of approximately 50 Royal Terns frequented the Cay Sal lagoon area. During periods of low tide they were nearly always found on the exposed sandbars or rocks on the west shore. A single specimen was collected on 23 April.

Zenaidura macroura macroura (Linnaeus). A single Mourning Dove, referable to the nominate subspecies, was taken on 18 April, thus establishing a second locality record for this taxon in the Bahamas. This subspecies has been previously known to occur in the Bahamas only on Great Inagua, where an adult male was taken in 1960 (Schwartz and Klinikowski, 1963). The species is quite numerous throughout the palm scrub of Cay Sal, seemingly indicating the presence of a breeding population established from Cuba.

Zenaida aurita (Temminck). The Zenaida Dove was included among specimens collected by Winch on Anguilla (Cory, 1891); however, none was observed by the senior author on Cay Sal, and no records exist for that island.

Coccyzus americanus americanus (Linnaeus). Yellow-billed Cuckoos appeared fairly common on Cay Sal, particularly in the scrub region at the north end where at least six sightings were made on 21 April. Previous records for the island have been noted by Cory (1891) and Riley (1905). Bonhote (1903) reported a specimen from the Cay Sal Light. The species has also been taken on Anguilla (Cory, 1891).

Speotyto cunicularia floridana Ridgway. There appears to be

some discrepancy regarding the status of the Burrowing Owl on Cay Sal. Cory (1891) referred to the species as being resident and not uncommon, his statement based upon observations and collections by Winch. Riley (1905) questioned Cay Sal as a locality for the species.

None was observed 18-24 April 1968 and the inhabitants of the island also failed to substantiate the existence of a breeding population of owls. Although one to several "owl sightings" have been made in recent years, these probably represent Cuban waifs or any number of several species and not a breeding population of *Speotyto*. Present evidence indicates that *Speotyto* is no longer extant on Cay Sal.

Caprimulgus carolinensis Gmelin. A Chuck-will's-widow was heard calling during the evening of 19 April. On the afternoon of 20 April a single bird was flushed from a dense thicket at the north end of the island, and on 23 April the same or another individual was flushed from a growth of mangroves.

Chordeiles minor chapmani Coures. A Common Nighthawk representing the southeastern continental subspecies was collected during midday on 21 April. Several others were regularly seen and heard calling during the evening hours. This is the second record of this subspecies from the Bahama Islands, whence an October-taken specimen was reported from Eleuthera (Schwartz and Klinowski, 1963).

Chordeiles minor vicinus Riley. One Common Nighthawk was heard calling in the manner characteristic of the West Indian subspecies *gundlachi* and *vicinus* (which we regard as distinct subspecies in contrast to the opinion of Bond, 1956, p. 88) on 19 April, and a single individual, resting on a palm frond in fairly open terrain, was collected during the afternoon of 20 April. *Ch. m. vicinus* is the breeding subspecies of Common Nighthawk in the Bahama Islands and the Florida Keys; whether Cay Sal supports a resident population of *Ch. m. vicinus* or whether these birds were transients bound for Florida or elsewhere in the Bahamas is unknown.

Chaetura pelagica (Linnaeus). A single Chimney Swift was observed in flight on the morning of 19 April. The bird made several passes over the south end of Cay Sal, flying about 25 meters above the surface of the ground, then disappeared from view. The

species is regarded as an uncommon migrant in the West Indies (Schwartz and Klinikowski, 1963, p. 65).

Calliphlox evelynae (Bourcier). Riley (1905) noted the Bahama Woodstar as occurring on Cay Sal. None was observed by the senior author, but on 21 April a relatively large hummingbird was seen flying over the island, headed out to sea in a southerly direction. The bird appeared too large to be a *Calliphlox*; however, unfavorable sighting conditions precluded any attempt at identification beyond the family level.

Ceryle alcyon alcyon (Linnaeus). Belted Kingfishers were regularly observed in the mangrove zone of Cay Sal. At least one to three sightings were made daily from 18 to 24 April.

Sphyrapicus varius varius (Linnaeus). On 19 April a Yellow-bellied Sapsucker was seen foraging in a growth of coconut palms near the west shore of Cay Sal. On 22 April another sighting was made in the same area and the specimen, in female plumage, was collected.

Tyrannus dominicensis dominicensis (Gmelin). Gray Kingbirds were observed in abundance on Cay Sal. Two specimens were collected on 18 and 21 April. Specimens were also secured by Winch (Cory, 1891), and Riley (1905) also noted the occurrence of Gray Kingbirds on Cay Sal.

Callichelidon cyaneoviridis (Bryant). Bahama Swallows have been recorded from Cay Sal by Cory (1891) and Riley (1905). The species was also taken on Anguilla by Winch (Cory, 1891).

Riparia riparia riparia (Linnaeus). A single Bank Swallow was observed in flight during the early morning of 19 April. The species is regarded as a rare spring transient through the Bahamas (Bond, 1956, p. 17).

Hirundo rustica erythrogaster Boddaert. One Barn Swallow was collected on 19 April, and many others were clearly observed. Previous records for the bank have been Riley (1905) and Cory (1891) for Cay Sal and Cory (1891) for Anguilla.

Mimus polyglottos orpheus (Linnaeus). A single individual of the Northern Mockingbird was observed and collected on 22 April in sparse shrubbery at the southern end of the island. Although suitable habitat is present, it may be incorrect to assume the existence of a breeding population of this species on the basis of one individual. This is particularly so when one takes into account the

small size of Cay Sal, the amount of time spent in the field, and the usually overt nature of the species. Were there others on the island, their presence would most likely have been made manifest. It would seem, therefore, that this species has not established itself or, at least at present, is not permanently established on Cay Sal.

Mimus gundlachii gundlachii (Cabanis). One Bahama Mockingbird was observed and collected in dense shrubbery on 23 April. The status of this species on Cay Sal is similar to that of *M. polyglottos* as discussed in the preceding account.

Dumetella carolinensis (Linnaeus). Several Catbirds were observed in dense scrub, and one specimen was secured on 21 April.

Catharus minimus bicknelli (Ridgway). A Bicknell's Thrush was collected on Cay Sal by Winch in May 1891 (Cory, 1891). This specimen represented the first record for the West Indies at that time and is still the only record for the Bahama Islands.

Polioptila caerulea (Linnaeus). In addition to resident breeding populations of Blue-gray Gnatcatchers, the Bahamas also play host to winter visitors from the continent. During the non-breeding season, there also occurs (in all probability) a considerable amount of interisland dispersal among the resident birds. These factors prevent a true assessment of the status of any particular individual observed on any one island outside the breeding season. The above holds true for two individuals from Cay Sal: one observed on 18 April, the other collected on 20 April.

Vireo crassirostris crassirostris (Bryant). A single Thick-billed Vireo was collected in a growth of mangroves on 22 April. Several other sightings were made in similar habitat situations.

Vireo olivaceus (Linnaeus). On 22 April a Red-eyed Vireo was observed in mangroves on the south side of Cay Sal.

Mniotilta varia (Linnaeus). Several Black-and-white Warblers were observed, and one specimen was taken on 21 April. The species was most often seen in association with coconut palms where the birds would spiral about the perimeter of the trunks in true *Mniotilta* fashion or feed amidst the flowering panicles which attracted numerous small insects.

Two Black-and-white Warblers were collected from the Cay Sal Light on 13 March 1901 (Bonhote, 1903). The occurrence of the species on Cay Sal has also been noted by Riley (1905).

Limnothlypis swainsonii (Audubon). The acquisition of a Swainson's Warbler on 24 April extends the known spring period for this species in the West Indies. This unobtrusive little warbler is probably more common as a transient in the Bahamas than is indicated by the negligible number of recorded sightings. However, its somber coloration and pattern, non-vocal ways in migration, and predilection for dense scrub or woods make it an exceedingly difficult species to locate. The specimen collected during the present study was located by the rustling sounds it made while foraging among dry leaves beneath a growth of *Conocarpus*.

Helmitheros vermivorus (Gmelin). One Worm-eating Warbler was collected on 19 April. No other sightings were made.

Vermivora bachmani (Audubon). Bonhote (1903) recorded a Bachman's Warbler taken from the Cay Sal Light by Solomon on 13 March 1901, and Riley (1905) listed Cay Sal as a locality for species.

It would be reasonable to assume that this species is (or was) a regular transient on the islands of the Cay Sal Bank or was possibly even a seasonal visitor because of the islands' proximity to Cuba where numerous winter observations have been made.

Vermivora peregrina (Wilson). A Tennessee Warbler, observed in dense scrub on 20 April, represents the first record of this species from Cay Sal.

Parula americana (Linnaeus). A large "wave" of migrant Parula Warblers arrived at Cay Sal during the night of 19-20 April, and regular sightings were made daily thereafter. One specimen was collected on 20 April. Solomon procured eight specimens (six males and two females) during the night of 13 March 1901 after they had struck the Cay Sal Light (Bonhote, 1903). Riley (1905) also noted the occurrence of the species on Cay Sal.

Dendroica tigrina (Gmelin). Cape May Warblers were among the most common of migrants observed on Cay Sal. Particularly large numbers were seen following a heavy influx of several warbler species during the night of 19-20 April; one specimen was collected on 19 April.

Dendroica caerulescens caerulescens (Gmelin). A specimen of Black-throated Blue Warbler representing the nominate subspecies was collected on 20 April. Several others of this species were regu-

larly seen in sparse scrub near the upper beach zone. *D. caerulescens* has also been taken on Anguilla (Cory, 1891; Riley, 1905).

Dendroica caerulescens cairnsi Coues. One representative of the montane race of Black-throated Blue Warbler was collected on 20 April.

Dendroica coronata (Linnaeus). In addition to Riley's (1905) listing of Cay Sal as a locality for the Myrtle Warbler, Bonhote (1903) reported on specimens collected by Solomon from the Cay Sal Light: one on 13 March 1901 and seven on 15 December 1901. None was observed during the senior author's visit to the island.

Dendroica striata (Forster). Blackpoll Warblers were among the most common of migrants observed on Cay Sal. A particularly heavy influx of this species took place during the night of 19-20 April. One specimen was collected on 19 April. The species has also been taken on Anguilla (Cory, 1891; Riley, 1905).

Dendroica pinus achrustera Bangs. This subspecies of Pine Warbler occurs in the Bahamas on Grand Bahama, Great Abaco, Andros, and New Providence. There is one record for Cay Sal where a specimen was collected by Winch in May 1891. The subspecific identification was originally made by Hellmayr, and this identification was later substantiated by James Bond (1966 supplement, p. 11).

The lack of any pine woods (or even isolated pine trees) on Cay Sal is a determinant against the establishment of a breeding population of Pine Warblers, a species which throughout its range exhibits rather rigid habitat requirements for conditions not present on this island or any of the other islets on the bank. The subspecies is also apparently non-migratory, and the occurrence of an individual so far removed from its normal range is a highly unusual circumstance. Tropical storms, which often provide an explanation for such disjunction, do not in this case provide a ready answer, as most storm paths are in a direction nearly opposite to that required to bring a *D. p. achrustera* to Cay Sal.

There is a possibility that the specimen collected represents an aberrant continental individual with a range of characters similar to that of the Bahamian form, although continental Pine Warblers are not regular migrants to the West Indies. *D. p. pinus* has recently been taken in Cuba (Bond, pers. comm.) and *D. p. florida* on the Dry Tortugas (A.O.U. Check-list, 1957, p. 502). The probability

of two such events actually taking place synchronously, however, are such as to make this an unlikely possibility. It would seem that the specimen is best regarded as a vagrant from one of the above mentioned Bahama Islands known to support that subspecies; the most likely possibility is that the bird came from Andros, which is the nearest island where *D. p. achrustera* occurs.

Dendroica discolor (Vieillot). Prairie Warblers were extremely abundant on Cay Sal. This species was included in the heavy influx of warblers that took place the night of 19-20 April. One specimen was collected on 19 April.

Dendroica palmarum palmarum (Gmelin). Palm Warblers were abundantly present on Cay Sal with particularly heavy concentrations along the air strip and upper beach zone. One specimen was collected on 19 April. Solomon acquired eight specimens from the Cay Sal Light; six on 13 March 1901 and two on 15 December 1901 (Bonhote, 1903).

Seiurus aurocapillus (Linnaeus). Two Ovenbirds were observed on 20 April, and one specimen was taken on 21 April.

Seiurus noveboracensis (Gmelin). Several Northern Waterthrushes were observed in a mangrove swamp, and one specimen was taken on 20 April. The occurrence of this species on Cay Sal has been noted by Riley (1905) and Cory (1891).

Oporornis agilis (Wilson). The Connecticut Warbler is a rare migrant in the West Indies. One specimen was taken on Cay Sal by Winch in May 1891 (Cory, 1891; Riley, 1905).

Geothlypis trichas (Linnaeus). One migrant Common Yellowthroat was collected on Cay Sal on 18 April, and many others were observed daily through 24 April. Winch collected the species on both Anguilla and Cay Sal (Cory, 1891; Riley, 1905) and Solomon procured seven specimens from the Cay Sal Light: four males and two females on 13 March 1901 and one female on 15 December 1901 (Bonhote, 1903).

Wilsonia citrina (Boddaert). Two Hooded Warblers (a male and a female) were collected on Cay Sal on 20 April.

Setophaga ruticilla (Linnaeus). Redstarts appeared common on Cay Sal; one specimen was collected on 21 April. The species has also been taken on Anguilla (Cory, 1891; Riley, 1905).

Piranga olivacea (Gmelin). One male Scarlet Tanager was ob-

served on Cay Sal on 19 April. The species is considered a rare transient in the West Indies (Bond, 1956, p. 166).

Icterus spurius spurius (Linnaeus). A single specimen of Orchard Oriole was taken on Cay Sal on 19 April, representing the first record for the Bahamas. A questionable sighting of this species from Eleuthera (Bond, 1956, p. 122) was later found to pertain to *I. galbula* (Bond, 1957, suppl., 2, p. 10). Previous records for the West Indies include several observations or specimens collected from Cuba and the western portion of the archipelago (Bond, pers. comm.).

Agelaius phoeniceus bryanti Ridgway. The Red-winged Blackbird is known from the northwest Bahamas and from Cay Sal whence at least one specimen was secured by Winch in May 1891 (Cory, 1891).

None was observed during the senior author's visit to the island, and no suitable habitat appeared available for this typically fresh water marsh inhabitant. Cory (1891) referred to the presence of a fresh water pond in the interior of Cay Sal. However, no such pond was found by the senior author despite a rather thorough search of the entire island. Parched basin-like areas were found, but these appear to function only as temporary reservoirs after heavy rains. The inhabitants of Cay Sal also deny the existence of any permanent bodies of fresh water on the island.

If in the past the pond referred to by Cory was indeed a permanent body of water, then there may well have been a breeding population of *A. phoeniceus*; such a population would, however, have been far removed and isolated from the main range of an assumedly non-migratory subspecies.

Dolichonyx oryzivorus (Linnaeus). Two Bobolinks were collected on 21 and 23 April, and seven individuals were observed feeding on the air strip on the latter date. All birds were in male plumage. Three males in full plumage were taken from the Cay Sal Light by Solomon on 28 March 1901 (Bonhote, 1903), and specimens have also been secured from both Cay Sal and Anguilla by Winch (Cory, 1891; Riley, 1905).

Passerina cyanea (Linnaeus). One male Indigo Bunting was collected on Cay Sal on 19 April.

Passerina ciris (Linnaeus). One male Painted Bunting was col-

lected on Cay Sal on 20 April, and several females were observed on separate occasions.

Ammodramus savannarum (Gmelin). Eight Grasshopper Sparrows were collected by Solomon from the Cay Sal Light on 15 December 1901. Presumably these are referable to the continental subspecies *A. s. pratensis* (Vieillot) which regularly winters in Cuba and the Bahamas.

DISCUSSION

Schwartz (1968a) has discussed the herpetofauna of the Bahama Islands; he showed that it is possible to divide the amphibians and reptiles of the Great Bahama Bank into two major groups, one (five species) which are members of an "old" Great Bank fauna and the other (14 species) which he considered to be the "new" Great Bank fauna. The former are remnants of a previously widespread Bahamian group which was more or less eradicated by Pleistocene inundation of the archipelago but which was able to persist in particularly favored areas; the latter is a recently arrived, post-Pleistocene, fauna from Cuba and Hispaniola.

Of the Cay Sal Bank reptiles, one (*Tropidophis canus*) belongs to the former group and four (*Sphaerodactylus decoratus*, *Anolis carolinensis*, *Anolis sagrei*, *Typhlops biminiensis*) to the latter. The five Cay Sal species represent one-fourth of the total number of amphibians and reptiles reported from the Great Bahama Bank. Two facts are noteworthy: 1) there is no radical Cuban element in the Cay Sal Bank herpetofauna, despite the proximity of the bank to the northern Cuban coast, and 2) several widespread and ecologically tolerant species from the Great Bank have not reached the Cay Sal Bank. We might with propriety expect that some common Cuban species might have reached the Cay Sal Bank; species such as *Alsophis angulifer*, *Dromicus andreae*, and *Anolis homolechis*, to name but a few, which are widespread in Cuba, would seem likely candidates for fortuitous natural transport to the Cay Sal Bank. But in fact even such widespread Cuba-Bahama species as *Ameiva auberi*, *Sphaerodactylus notatus*, and *Leiocephalus carinatus* appear to be absent from the Cay Sal Bank, despite their broad distributions in Cuba.

The absence of amphibians on the bank is also puzzling. The

two Bahamian frogs (*Hyla septentrionalis*, *Eleutherodactylus planirostris*) are also widespread in Cuba; at least *E. planirostris* has been taken on remote and isolated islets (i.e., Green Cay) in the Bahamas so that the geographic location of the Cay Sal Bank can hardly be invoked as reason for the absence of this species. *Hyla septentrionalis* likewise is adept at colonizing distant islands throughout its Bahamian range (Rum, San Salvador). It seems likely either that 1) the herpetofauna of the Cay Sal Bank includes more species than have been reported herein, or that 2) the far-flung nature of the bank and its geographic position has very strongly militated against dispersal to it from the Great Bahama Bank itself. Such a very small portion of the Great Bank herpetofauna occurs on the Cay Sal Bank that the chance nature of arrivals there from either the Bahamas or Cuba is surely a prime factor in the composition of its total herpetofauna. In addition, the irregular nature of the records of the species which do occur on the bank (i.e., *S. decoratus* only on bleak Elbow Cay, *T. biminiensis* on the same island, *A. carolinensis* on Cay Sal and the Anguilla Cays but not Elbow Cay) add further evidence of the chance nature of overseas colonization to a bank of widely scattered and small land masses. Doubtless, also, the lack of ecological diversity (on Elbow Cay, for instance, where *Anolis carolinensis* does not occur) may have prohibited the survival of overseas waifs in some instances.

Seventy-two species of birds have been presently recorded for the Cay Sal Bank. *Dendroica caerulescens* and *Chordeiles minor*, each represented by two subspecies, bring the total to 74 forms. Of these, 71 have been observed on Cay Sal, 12 on Elbow Cay, and 10 on the Anguilla Cays.

Approximately two-thirds of the total number of species recorded are North American migrants. The position of the Cay Sal Bank nearly midway between Cuba (where vast numbers of North American forms overwinter) and Florida is highly suited for attracting a rich transient avifauna; the many islands and islets of the bank provide the only resting and "refueling" sites between the coastal *cayeria* of Cuba and the Florida Keys. The bank is also far removed to the west of the remaining islands of the Bahamas and as such is more likely to "catch" migrants travelling from the westernmost portion of the archipelago and from South and Central America across the Gulf of Mexico to the southeastern shores of

North America. *Icterus spurius* and *Catharus minimus*, each represented by single records in the Bahamas and both from Cay Sal, are cases in point.

The breeding birds of Cay Sal appear to be few in number, both in terms of species and in numbers of individuals. Of eight species most likely to represent breeding land birds on the island of Cay Sal, only three, *Zenaidura m. macroura* (identification of the *Zenaidura* population as the Cuban subspecies *macroura* is based upon one collected specimen), *Coccyzus americanus*, and *Tyrannus dominicensis* appeared fairly common. Previously recorded but not observed during the present study were *Calliphlox evelynae*, *Speotyto cunicularia*, and *Zenaida aurita* (recorded from Anguilla). Only one each of *Mimus polyglottos* and *M. gundlachii* were observed, and several individuals of *Vireo crassirostris*, probably representing a small resident population, were also seen.

All of the above forms except for the Cuban *Zenaidura* are typically Bahamian. Of note, however, is the complete absence of such more or less ubiquitous Bahamian species as *Columbina passerina*, *Chlorostilbon ricordii*, *Mimocichla plumbea*, *Dendroica petechia*, *Coereba flaveola*, *Spindalis zena*, *Tiaris bicolor*, and *Loxigilla violacea*. Of these, all but *Coereba* and *Loxigilla* occur in Cuba.

The old records for *Agelaius* and *Dendroica pinus* from Cay Sal probably represent vagrant individuals, as suitable habitat for either species is now non-existent. The recent sighting of *Eudocimus* also falls into this category. The first two undoubtedly originated from the northwest Bahamas, and the latter probably from Cuba.

Paulson (1966) commented on meteorological phenomena as a series of factors creating situations of constantly fluctuating populations on small islands within an extensive archipelago. His comments were made in reference to islands on the Little and Great Bahama Banks. This would seem to hold true for Cay Sal as well, particularly so because of its extreme small size, isolation, and relatively open and exposed terrain. A population of feral cats on Cay Sal, noted by the senior author, also must take a toll of any resident birds, and on such a small island may contribute significantly to the decimation of already meagre populations.

It is surprising that in spite of the island's relative proximity to

Cuba the influence of the latter island on the Cay Sal avifauna seems negligible, *Zenaidura m. macroura* representing the only known Cuban immigrant to have established itself. The human residents of Cay Sal have noticed an influx of different bird species following storms or "heavy blows" from the south (*Aratinga* was at one time brought to the island in such a manner). On other occasions, *Columbina*, *Columba leucocephala*, and "hawks and owls" have been seen. These may have been of Cuban origin, but we have not included them in the species accounts for lack of verification.

Much field work is yet to be done before a true assessment of the Cay Sal herpeto- and avifaunas can be made. In this respect the present study can best serve as a preliminary survey. There are many islands on the bank, most of which have not been visited at all by scientists, and those from which collections have been made have been insufficiently worked. In one week on one island the senior author alone accounted for 41 species of birds heretofore unrecorded from the entire bank, and Thomas's reptilian collection from Elbow Cay, made in a part of a single day, although less impressive in numbers of species, added two forms to the bank herpetofauna. Extensive field work from late spring through the summer months would be most instructive and is indeed necessary for determining the breeding species of birds and the true faunal affinities of the Cay Sal Bank.

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