

Distribution of Cattle Egret Roosts in Hawaii With Notes on the Problems Egrets Pose to Airports

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In 1959, 105 Cattle Egrets (*Bubulcus ibis*) were released throughout the Hawaiian Islands by the State Department of Agriculture in an effort to control arthropod pests of cattle (Breese 1959). Subsequent information on egret proliferation is limited, but it is evident that egrets began nesting soon after they were released on Oahu (Rockafellow 1960, Thistle 1963). Large populations of egrets are now established on Oahu and Kauai (Byrd, et al. 1980), with smaller populations on Maui (M. Ueoka and C. Kepler pers. comm.), Molokai (Walker 1983), and Hawaii (this study). Although egrets have been recorded on Lanai (L. Hirai pers. comm.) and Niihau (T. Telfer pers. comm.), no permanent roosts have been documented on these two islands. We know of no records of Cattle Egrets on Kahoolawe.

Recently, egrets have become pests at prawn farms on Oahu, where the egrets prey on prawns, and at airports in Honolulu, Lihue, and Hilo. Several near misses between large egret flocks and airplanes resulted in the Federal Aviation Administration (FAA) contracting the U.S. Fish and Wildlife Service (USFWS) in January 1982 to initiate a study of the ecology of cattle egrets in the Hilo area. The baseline data gathered was to be used to postulate potential control techniques for egrets at the Hilo airport.

The primary objectives of the study reported here are: 1) the documentation of the distribution and abundance of Cattle Egrets throughout Hawaii; 2) quantification of the habitat correlates of roosts throughout the state; and finally 3) to report on the nesting ecology of egrets at Lokoaka Pond, the primary heronry in the Hilo area.

STUDY AREA AND METHODS

To accomplish our first two objectives of documenting the status of egrets in Hawaii, we analysed responses to questionnaires sent to 62 biologists in Hawaii (21 were returned) by the State Department of Health. Biologists were asked to report any known egret roosts, nesting records, site histories, and habitat characteristics. In addition, we attempted to locate and census birds at all roost sites on Hawaii Island, and the large roost at Kahuku on Oahu. We also reviewed the literature for information on egrets in Hawaii.

For the third objective, the primary study area was a small island in Lokoaka Pond, 1 km north of General Lyman Field. Egrets on the island occupied a dead 8-m tall Norfolk Island pine (*Araucaria heterophylla*) and an adjacent live 3-m high by 5-m wide banyan tree (*Ficus* sp.).

We determined numbers of active nests weekly (i.e. nests with visible young or incubating adults) from January to March 1982 by

using a 15-60 x spotting scope. Paton censused the roost opportunistically from 1980 through 1982. From April to July 1982, we visited the roost site weekly by boat to count active nests, eggs, nestlings, and "branchers" (mobile chicks over 4 weeks old).

The terminology we use throughout this paper is based on three categories of roosts: (a) TEMPORARY ROOSTS — sites used for less than 2 years, with egrets eventually returning to a permanent roost or heronry; (b) PERMANENT ROOST — sites used daily for more than 2 years, but no nesting recorded; (c) HERONRY — a roost where nesting has been recorded.

RESULTS AND DISCUSSION

Status of Cattle Egret Roosts in Hawaii

The statewide Cattle Egret population was estimated to be 13,000 egrets in June 1982, approximately 120 times the number of birds initially introduced in 1959 (Table 1). This population

Table I. Cattle Egret roost locations in Hawaii. Roost numbers correspond to roost locations in Figure I.

Island	Roost number	Location	Pop. est. (year)	Nesting	Years occupied
Kauai	1	Lumahai	50(80)	no	T
	2	Crater Hill	4000(81)	yes	11
	3	Kapaa	800(80)	no	7
	4	Hanamaulu	N/A	no	1(A)
	5	Kailiilihinale	N/A	no	T
	6	Huleia	N/A(80)	no	2(A)
	7	Huleia River	N/A	no	1
	8	Omao	3000(82)	yes	6
	9	Aepoeha Res.	N/A	yes	1
Oahu	10	Kahuku Point	3000+(82)	yes	25
	11	Heeia	1300(83)	?	2
	12	Kaneohe MCAS	1300(82)	yes	11(A)
	13	West Loch	150+(82)	yes	22
Molokai	14	Umipa'a	200+(82)	yes	?
Maui	15	Kanaha	407(83)	no	10
Hawaii	16	Aimakapa	6(82)	no	5
	17	Honokaa-1	8(82)	no	T
	18	Honokaa-2	50(84)	no	T
	19	Honokaa-3	44(84)	no	T
	20	Hilo Bay	20(82)	no	10(A)
	21	Naniloa Surf	150(82)	no	T
	22	Kionakapahu	150(82)	no	T
	23	Lokoaka	506(84)	yes	13
	24	Keauu Ranch	100(72)	no	T
	25	Kapoho	70(82)	no	T
26	Punalu'u	20(82)	no	T	

T = temporary roost.
(A) = abandoned roost.

estimate is subject to variation due to the uncertainty of census results at the larger roosts and the chance that some roosts were not found. For example, the heronry at Kahuku Point was difficult to census due to the size of arriving and departing flocks, egret behavior at this large heronry, and the physical location of the roosts. During our censuses, an unknown percentage of the birds at Kahuku Point departed and arrived while it was still dark making an accurate population estimate difficult (D.P. Fellows pers. observ.). Birds at smaller roosts, such as Lokoaka, did not usually move during periods of poor light conditions. Also, roosts may exist where extensive surveys were not conducted.

From the questionnaires, literature, and our own observations, we learned of 25 roost sites in Hawaii (Fig. 1), and we obtained at least anecdotal information on most of them (Table 1). The following is an annotated list on the status of Cattle Egret roosts in Hawaii.

Kauai-The status of egrets on Kauai is summarized in 1980 (Byrd et al. 1980). A total of four roost sites were known to be used in 1980; the largest and only heronry was at Crater Hill. In 1982, there were 3 active roost sites on the island totalling approximately 8,000 birds (Table 1). Several hundred birds were noted at Omao reservoir in the spring of 1979, and by January 1982, 3,000 birds were estimated to roost there. Only the Crater Hill site was known to be used by nesting egrets in 1982 (T. Telfer pers. comm.).

Since 1982, the status of roosts on Kauai has changed considerably. The Omao Reservoir permanent roost has become a heronry, as has the roost at Lono Reservoir, so there are now 3 heronries on Kauai. A new roost site was discovered at Aeopoha Reservoir, and a relatively new roost adjacent to the Lihue airport at Hanamaulu was disrupted and moved to Kaliilahinale Reservoir (T Telfer pers. comm.).

Oahu - The 25-year-old heronry at Kahuku is the oldest known roost site in the state. Over 3,000 birds were thought to be using Kahuku in 1982 (Table 1). Although birds have remained in the Kahuku area for 25 years, the exact roost site has shifted sporadically for unknown reasons. Egrets moved 2-3 km south to the initial roost site in the mid-1970s and then moved 1 km northward in early 1982 (R. Shallenberger pers. comm.).

A heronry existed near Kaneohe Marine Corps Air Station from 1971 to late 1981 or early 1982, then relocated to similar habitat 1 km away. The population then moved again, 6 km to the present Heeia site in late 1982 (R. Shallenberger and R. Coleman pers. comm.).

The number of egrets using the third reported egret roost site at Pearl Harbor's West Loch was probably underestimated due to access problems.

Maui- There has been no nesting of Cattle Egrets reported from Maui, although egrets have been on the island for at least 10 years. Forty egrets were first noted at Kanaha in 1975. By 1978, the Kanaha population had increased to 80 birds and continued to gradually increase to 120 egrets in January 1980, though no nesting was observed during this period (M. Ueoka pers. comm.). The birds roosted nightly for more than 3 years on emergent sedges 100 m from solid ground. In early 1982, the birds shifted their roost site 150 m to sedges closer to the edge of the pond, within 10 m of a dirt road (C. Kepler pers. comm.).

The Maui egret population increased dramatically from early 1982 to early 1983, from 120 birds to 407. Again, no nesting was observed during this population increase (M. Ueoka pers. comm.).

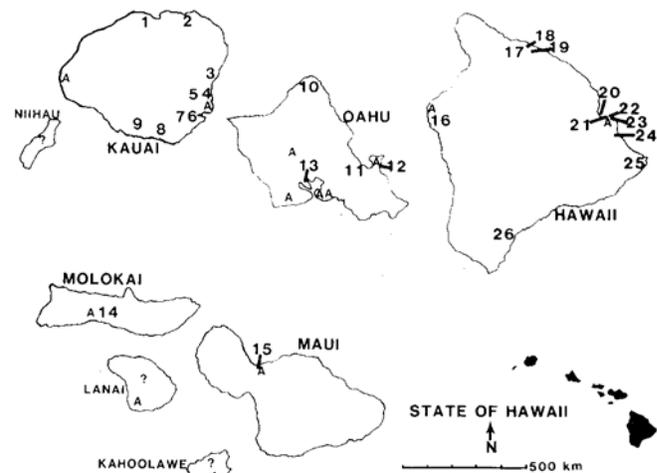


Figure 1. Location of Cattle Egret roost sites (numbers) and airports (A) in the Hawaiian Islands. See Table 1 for roost population sizes and present status.

Inter-island immigrants are the most plausible explanation to account for the large population increase.

Molokai - The Hawaii Division of Forestry and Wildlife semiannual waterbird surveys first noted Cattle Egrets on Molokai in the summer of 1974, but it wasn't until early 1983 that a heronry was found near Umipaa. Approximately 200 adult birds were counted at the heronry at 12:00 noon on 20 January 1983 with 90 nests structures, of which 30 were active (Walker 1983). Based on our censusing experience with Cattle Egrets at Lokoaka, a noon census would underestimate the number of birds actually using the roost by at least 2-3 times. Since we had no opportunity to visit the Umipaa roost, we left the population estimate at a conservative 200 birds.

Lanai - Like Molokai, Lanai is seldom visited by birdwatchers. The status of egrets remains uncertain. Several egrets were observed north of Lanai City in 1975-76, feeding with grazing horses (L. Hirai pers. comm.).

Hawaii- The history of the Lokoaka roost is poorly documented.



Location of the Lokoaka Pond heronry relative to General Lyman Field in Hilo.

Photo by Peter Paton



Lokoako Pond roost site in Hilo.

Photo by Peter Paton

The egret population is presumably descended from 32 egrets released on the island of Hawaii (12 at Keaau Ranch, 20 at Mahukona) in 1959 (Breese 1959). Lokoako Pond was used at least as early as January 1972, when Berger (1972) noted six egrets there. By February 1973, 30-40 egrets were roosting in the then live Norfolk Island pine at the present site (*Hawaii Tribune Herald* 2/11/73). In January 1978, at least 78 egrets were using the site (Pyle 1978). No nests were mentioned in any of the above accounts, and none were evident in the *Hawaii Tribune Herald* photo.

The first documented records of egrets nesting on Hawaii Island were in July 1980, when Paton (unpubl. field notes) counted 185 birds and 20 nests at Lokoaka. In December 1980, Paton counted 300 egrets and 32 nests. The population at Lokoaka had nearly doubled by the time the present study was initiated.

In mid-June 1982, 67 egrets were seen in a pasture adjoining Green Lake. Although the birds were roosting at Kapoho, birds that we had dyed confirmed that some, and possibly all, of the egrets had come from Lokoaka. No adequate census of the Kapoho population was obtained due to limited visibility and access problems. During the third week of July, the Lokoaka population increased by 130 birds and a subsequent check showed that the Kapoho roost had been abandoned. Discussions with area residents indicated seasonal (spring and summer) presence at Kapoho, suggesting that birds disperse from Lokoaka (possibly after breeding?) and return later in the year. This was the only evidence we had of possible seasonal movements of Cattle Egrets in Hawaii. The seasonal dispersal pattern of this sort could have been responsible for the large June to December increase noted in 1980.

All but one of the temporary roosts reported were on Hawaii Island (Table 1). This may only reflect our intensive survey and control efforts on that island. The temporary roosts at Kionakapahu and the Naniloa Surf Hotel were definitely established in response to egret control techniques initiated at Lokoaka, and the birds returned to Lokoaka when control ceased there. Destruction of the Shipman ranch roost tree in the early 1970s led to abandonment of the site. The Shipman Ranch birds then moved 11 km to Lokoaka and Hilo Bay. Egrets now only use the Shipman Ranch area occasionally as a temporary roost, staying for 1-2 nights and then leaving (R. Blackshear pers. comm.).

Status of the Hilo Bay roost is uncertain. Egrets roosted on

one or more of the navigational buoys in the bay from the early 1970s through at least 1980. Whether the buoys are still used and whether they were used continuously or intermittently is not known.

The relationship between the Punalu'u and Lokoaka population is unknown. Punalu'u was colonized in February 1982, when egrets were disappearing from Lokoaka. However, whereas Punalu'u was abandoned in August 1982, no additional egrets appeared at Lokoaka until December, when the population increased by 40 adults.

The origin of the Honokaa, Hawaii, birds is also unknown. The first Honokaa roost (Fig. 1, No. 17) was observed in December 1982, but the flock of eight birds remained only about 2 weeks. In the third week of December 1983, egrets again appeared at Honokaa where some 50 birds established a roost in mature sugarcane, 2 km east of the 1982 site. At the end of January 1984, the roost site changed to a second location in sugarcane 2.2 km to the east. The flock dwindled from about 40 birds in February and March to 27 on 16 April 1984. Four flew over the site on 24 April 1984, but roosted elsewhere, and no egrets were seen in the Honokaa area after 5 May 1984 (P.Q. Tomich pers. observ.).

Inter-island transients are a possible explanation for the origin of such birds, although they could have come from the Lokoaka heronry. Cattle Egrets are strong flyers and have been recorded on Midway, 2,000 km from the nearest roost on Kauai (P. Pyle pers. comm.).

Roost Habitat Correlates

Information reported here only includes data on 22 roosts found in the state; 4 roosts reported from Kauai (Hanamaulu, Kailiilihahinale, Huleia River, and Aepoeha Reservoir) were found after 1984 and not included in these analyses. Roosts throughout the Hawaiian Islands exhibited a number of similarities. Roosts tended to be situated at low elevations, averaging 30 m above sea level (s.d.=76.3), topographically level (85 percent of the total roosts), within 0.5 km of the ocean (80 percent, mean= 1.2, s.d.=1.7), and adjacent to water (95 percent). Seventy percent of the roosts were adjacent to fresh or brackish water. Only one roost, Lumahai, which is a temporary roost, was near a fresh water stream; natural or



Egrets with cattle on the Big Island in deep grass.

Photo by Peter Paton

man-made impoundments (reservoirs, fish ponds, sugar mill settling ponds) characterized the remaining roost sites. Recent research on Kauai suggests that roost site selection is not as uniform as the above data indicates (T. Telfer pers. comm.).

Since we did not do any detailed vegetation analysis of roosts throughout the state, only general trends can be discussed. Trees less than 10 m high served as substrate for heronries (mean height=6.7 m, s.d.=2.0, Table 2). Heronries on islands other than Kauai tended to be in habitat patches consisting of more than one substrate species (Table 2). The heronries at Omao, Lono reservoir, and Kaliiliahinale are in 100 percent Hau (*Hibiscus tiliaceus*) (T. Telfer pers. comm.).

Permanent roosts and temporary roosts, on the other hand, were situated in uniform habitat patches. Much of the substrate used by birds in permanent and temporary habitat was not suitable for nest building. Nesting on Maui would require the birds to relocate out of the sedges. Sugarcane (Honokaa 2 and 3) is another substrate that is unsuitable for nesting, as it offers no support for nesting material. No obvious differences could be noted between heronries and permanent roosts in terms of substrate used, except on Maui. The only roosts located in trees over 10 m high were temporary roosts.

Breeding Biology

It is evident from Table 3 that egrets breed virtually year-round at Lokoaka. There was no period from January through June 1982 without young and/ or eggs at the heronry tree. The 1982 nesting cycle at Lokoaka exhibited sharp peaks in January and June. Nesting ceased from July through September 1982, as a result of eradication efforts, though the atrophied gonads of egrets collected during this period suggest nesting might have been low without control. Egrets nested at Omao, Kauai from July to at least September 1985, showing that some egrets in the state nest during the late summer months. (T. Telfer pers. comm.).

Table 2. Roosting substrate of Cattle Egrets in Hawaii. Each number represents an individual roost. Numbers less than one are for the proportion of a roost in a particular habitat.

Species	Roost type		
	Temporary	Heronry	Permanent
Hau (<i>Hibiscus tiliaceus</i>)	2	0.3	3
Koa haole (<i>Leucaena glauca</i>)		1.8	
Ironwood (<i>Casuarina</i> sp.)	1	0.5	
Christmas Berry (<i>Schinus terebinthifolius</i>)		0.3	1
Mangrove (species unknown)		1.5	1
Kiawe (<i>Prosopis pallida</i>)		0.5	
Unidentified emergent sedges			1
Shower Tree (<i>Albizia</i> sp.)	1		
Coconut Palm (<i>Cocos nucifera</i>)	2		
Norfolk Island (<i>Araucaria heterophylla</i>)		0.5	
Banyan (<i>Ficus</i> sp.)		0.5	
Cecropia (<i>Cecropia peltata</i>)	1		
Sugarcane (<i>Saccharum officinarum</i>)	2		
Harbor Buoy	1		

Table 3. Maximum number of Cattle Egret nests observed by month at Lokoaka Pond.

Month	Number of active nests			
	1980 ¹	1981 ¹	1982	1983 ⁵
January	- ²	8	66	34
February	-	34	57	52
March	-	-	57	56
April	-	0	23	36
May	-	-	59	46
June	20	-	70	45
July	-	21	70 ⁴	31
August	-	-	0 ⁴	
September	-	-	1 ⁴	
October	1	+ ³	15 ⁴	
November	32	+	38 ^{4,5}	
December	-	36	25 ^{4,5}	

¹1980-81 data from Paton, unpub. field notes.

²Dashes indicate no data.

³Plus indicates nests present but not counted.

⁴Ongoing adult control at roost.

⁵Chicks being removed at 2-4 week intervals.

In September 1982, one pair attempted to nest at the Lokoaka heronry, but trapping efforts caused nest abandonment. To attract the population back to the heronry, birds were allowed to start nesting again in October 1982. Within 3 weeks, 38 nests, containing an average of 2.58 eggs each, were built.

Clutch size ranged from two to six, with a mean of 3.32 eggs per nest (s.d.=1.06, n=41). The mobility of "branchers" precluded direct estimation of fledging success from individual nests. Instead, we compared the numbers of young "branchers" present on each visit with the numbers of 1-week-old young counted 3 weeks previously. Based on this, an average maximum of 0.6 chicks per nest reached the "brancher" stage in the spring of 1982. True fledging success was much lower due to extensive nest failure during incubation and moderate loss of older branchers. Taking these factors into consideration it appears unlikely that production exceeded 0.1-0.2 young per nest during the study period.

The percentage of the total Lokoaka population engaged in breeding activities varied throughout the study. Because egrets were not individually marked it is not known if the same adults were nesting more than one time per year or if different adults were nesting during different months of the year. Cattle Egrets are unique among the Ardeidae in that they are the only species able to breed when they are 1 year old (Kohlar 1966). In January 1982 an estimated 64 nests were active; that is, 23 percent of the total Lokoaka population (128 of 540 birds) were engaged in breeding activities. By 1 June, part of the Lokoaka population had dispersed to Kapoho, leaving 350 birds, of which 50 percent were nesting (70 nests). On 1 November 1982, the Lokoaka population was 175 birds and 38 nests were recorded (43 percent).

DISCUSSION

One of the primary purposes of this paper is to provide baseline data on roost locations throughout the Hawaiian Islands for researchers doing work with egrets. Cattle Egrets will undoubtedly continue to conflict with human interests if egrets keep

using airports as feeding grounds. Recently, egrets began to pose a serious airstrike hazard at the airport in Lihue, Kauai.

Population increases of Cattle Egrets are cause for concern to airport managers throughout the islands, due to the propensity of egrets to forage in grasslands associated with airport landing strips. Kauai has four large roosts within Cattle Egrets' normal daily flight range of the Lihue airport, with upto 200 birds feeding at the airport at one time (T. Telfer pers. comm.). The West Loch roost is relatively close to Honolulu International Airport (HON). HON was experiencing small congregations of egrets (10-50 birds) during the second half of 1982, though no egret-airplane collisions were reported during the study period. The permanent roost at Kanaha is within 1 km of the Kahului airport, the second busiest commercial airport in the islands. Though no congregations of egrets have been reported at the Kahului airport, the recent influx of egrets to Kanaha has increased the probability of an airstrike.

The heronry at Lokoaka still has a high probability of an egret-airport collision. A control program initiated in June 1982 diminished the Lokoaka population from 540 to 150-160 by August 1983 (Fellows et al. in press). The control program ceased due to the closure of the Hilo U.S. Fish and Wildlife Service animal damage control office. The egret population subsequently built up rapidly and was estimated at 506 birds on 20 January 1984 (P.Q. Tomich pers. observ.). Due to the proximity of this heronry to General Lyman Field and the location of the egrets' primary feeding areas on the opposite side of the airport from the heronry, the Lokoaka population will continue to pose a serious threat to Hilo air traffic.

Year-round reproduction by a substantial proportion of individuals within each heronry is a possible reason for the dramatic increase of this species in the islands. Although fledging success was relatively low during our study at Lokoaka, the Lokoaka population rapidly increased during the second half of 1983. Reasons for the poor nesting success at the Lokoaka heronry are uncertain, but some causes might have been: 1) predation by Black-crowned Night-Herons (*Nycticorax nycticorax*), which we observed on 3 occasions; 2) wind destruction of exposed nests on the bare branches of the roost tree; 3) our constant visits to the nest tree.

Based on roost habitat correlates, potential roost sites would be hard to identify with precision. The geologically older islands, Kauai and Oahu, have proportionally more standing water and therefore more potential roost sites. Egrets in South Africa and Texas also have the same attraction to areas near water for roost locations (Ramsey 1977, Seigfried 1971).

RECOMMENDATIONS

Cattle Egrets can be highly transient and results of population reduction programs at specific roost sites will probably be short-lived. Egrets are now well established on 5 of the main islands, and attempts to eradicate egrets on one island will only provide a short term solution to pest problems. Inter-island movements are likely to be a common occurrence which cannot be prevented.

Roost relocation is probably not a viable solution to help alleviate problems caused by egrets. Information gathered during our study suggests that relocations will only be temporary, with the egrets eventually returning to their old roost site. In addition, our studies of egret feeding patterns, together with work done on Kauai in 1985, show that egrets will travel over 15 km daily to reach a feeding site (Fellows et al. in press, T. Telfer pers. comm.). The

feasibility of moving an egret roost great distances are minimal.

Although lethal control measures may be necessary to alleviate problems caused by Cattle Egrets in some cases, the ultimate solution for long-term control lies in development of behavioral modification techniques which repel egret flocks from airports. Cattle Egrets are now another member of the list of "biological control agents" introduced to Hawaii which have gone astray from their intended mission and humans today must learn to cope with them.

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