The status of Sooty Terns (*Sterna fuscata)* on Ascension Island, South Atlantic

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Introduction

The aim of the work described here was to determine the status of the breeding population of Sooty Terns (Wideawakes) *Stema fuscata* on Ascension Island. Ascension is a small volcanic island isolated in the tropical South Atlantic Ocean at 07 degrees, 57 minutes south and 14 degrees, 24 minutes west, approximately midway between South America and Africa. Historic records indicate that in the eighteenth and nineteenth century's large colonies of Sooty Terns once nested on the plains of Ascension Island. In this century the two most widely quoted population estimates are for the year 1942 when (J.P.Chapin 1954) suggested there might be a million birds and for the years (1957-59) when (N.P.Ashmole Ibis 1963) estimated a population of 750,000 birds. Population estimates of Sooty Terns on Ascension Island have based on calculated guesses, no previous survey of the population are know to exist.

Sooty Terns return to Ascension every 9.6 months to nest. The bird spends most of their time on the wing and return to Ascension Island in large numbers only to breed. Their numbers on the island at anyone time vary greatly and for three months in every nine the entire population is absent Sooty Terns are widespread and numerous, breeding in tropic and sub-tropic zones of the Atlantic, Pacific and Indian Oceans. However, the breeding population on the Island is significant in global terms because it is a major colony and one of the largest in the South Atlantic. Ascension Island is the only site in half a million square kilometres of ocean for these birds to nest.

Method

During this decade the Army Ornithological Society (AOS) has mounted five expeditions to Ascension. The main aim of each expedition was to determine the Sooty Tern population during a particular breeding season. Only adult breeding pairs were counted, juveniles and non breeding adults been largely absent from the Island. Each expedition consisted of a team of approximately ten amateur ornithologists. The majority of these volunteers were serving soldiers but representatives from the other armed services, ex-service personnel and one professional ornithologist also took part in the census. Each of the five expeditions visited the island for a period of approximately two weeks. Sooty Terns are gregarious and their breeding ground or "fairs" currently extend on the Island to about ten hectares with an average density of two pair per square metre. The Ascension colony of Sooty Terns situated in the south west comer of the island, divides geographically into two sub colonies one situated at Mars Bay and the other, known as the Waterside Fairs, situated at the north end of the airfield near Pillar Bay (Figure1). Both sub colonies contain individual fairs, the number of these fairs vary season by season. The populations are far too large for a complete count to be conducted, so all of the censuses estimated mean clutch densities in sample quadrats and extrapolated this value to the estimated area of the colony.

The dates of each expedition were selected to coincide with the breeding season of the Sooty Terns. The maximum number of Sooty Terns occur on the Island approximately 6 weeks after the first egg of the season is laid (Ashmole 1963). The expeditions dates were planned so as to enable the census to be started during week six of the breeding season.

Timing of the Surveys

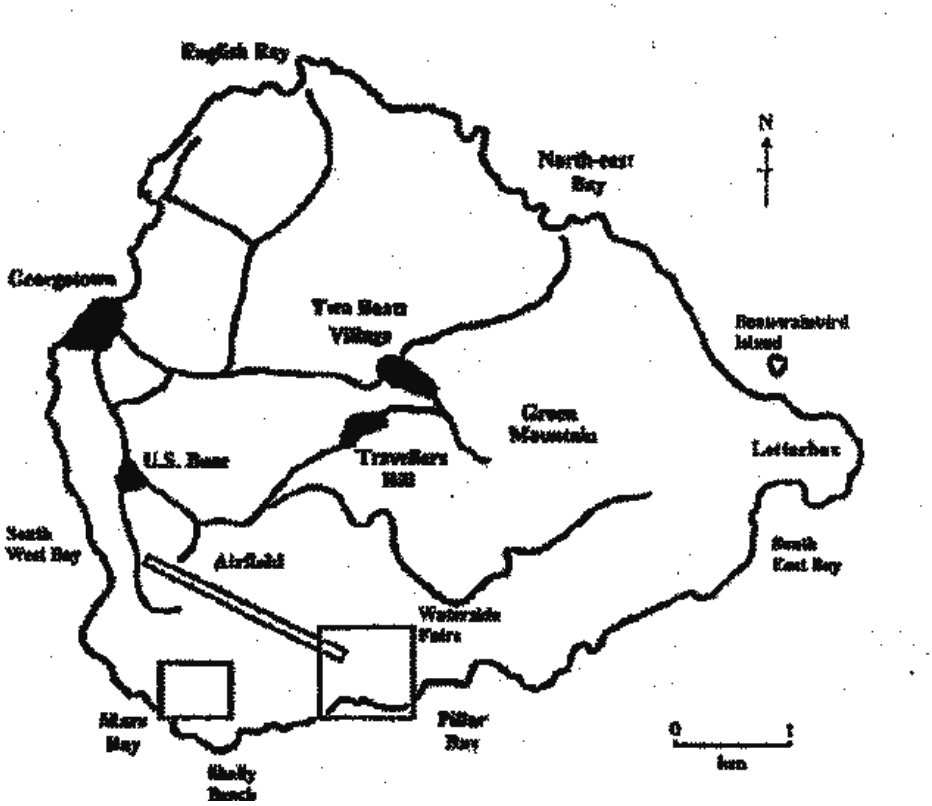
The greatest difficulty in carrying out and replicating the surveys was that of timing. The size of the colony can expand between day 30 and day 42 of the breeding season by as much as 29%. Surveys undertake before the 42nd day are likely to seriously under estimate the size of the colony. To obtain reliable results it is necessary to carry out the survey within a period of between 40 and 60 days after the first eggs of the breeding season been laid. Predicting, planning and arriving on the island during this critical period proved difficult to achieve.

Wideawake Calendar

To help with planning a detailed calendar of Sooty Tern breeding dates was produced. Their breeding cycle has been variously reported as being 42 weeks, nine and a half months, 9.6 months and 10 lunar months. The most accurate figures for the length of breeding cycle were determined as being 293 days (Chapin 1954) and 297 days (Ashmole 1963). The mean of these two figures ie 295 days has been used by the AOS to calculate the predict start dates for laying. The datum for start of laying was identified as been 9 Feb 90

(Lowery F. 1990) and AOS field observations identified the first egg to hatch in that season as been 12 March 1990. These dates were used as the datum to calculate the start of laying for future breeding cycles. As additional dates became available the calendar was updated.

A typical breeding cycle for a single Sooty Tern follows this pattern. Firstly a mass landing of birds takes place on their fairs during day time. A single egg is laid within the next day or two which is incubated for 28 to 30 days. Rearing of a chick takes a further two months. Then the tern returns to the ocean where it lives on the wing for four and a half to five months until the start of the next night club activity. Initially small groups of terns come in from the sea during the middle of the night and mill around over their fairs. The length of time over land and the number of birds gradually increase. Eventually the terns land again for a short while. This length of time on the ground is gradually increased until day time occupation of the fairs commences once again. Other Sooty Terns follow the first mass landing so the total breeding activities first egg to departure of last young extends to about 6 months. Sooty Terns are on the ground for a further period of 2-6 weeks during the night at the latter stages of their night club activity. Thus in anyone breeding period of 9.6 months some Sooty Terns are on the ground of Ascension Island for all but two or three months.



The Two boxes in the S.W. corner of the map are the areas in which Sooty Tern sub colonies occur.

Locating the Fairs

Stonehouse (1962) traces the gradual southward move of the fairs in the nineteenth century across the plains of Ascension Island to their present location. Sooty Terns eggs were collected for human consumption. In the 1830's in one week 120,000 eggs were collected and the collecting season lasted between one and two months (Hart-Davis 1972). Now the breeding distribution is entirely restricted to the coastal plain between Mars Bay and Pillar Bay (Figure 1). During each expedition the Island was searched but no Sooty Terns were ever found breeding outside the Mars Bay-Pillar Bay area. Censuses of the coastal plain between these two bays can therefore be regarded as population estimates for Ascension as a whole.

Mapping the Fairs

Each fair was surveyed separately. The number of fairs in the seasons surveyed varied between 5 and 14. Some fairs can be large 4 or 5 hectares and others small 0.02 hectares. Cairns of lava rock approximately 0.6m high and circled with a strip of orange or white plastic were built around the perimeter of the fairs. The cairns were built at intervals of approximately 60m and at each change of direction of the fair's perimeter. The Sooty Terns nested in many cases right up to the boundary marked by the cairns. However the edges of the fairs are not symmetrical and the cairns marked out the mean perimeter edge. A circular compass and

pace traverse was run between the cairns and closed back on the starting point. Forward and reverse bearings were taken with a Mils prismatic compass. The distance were paced and checked for gross error by the use of a pedometer. The traverses were then plotted on Chartwell I mm squared graph paper at a scale of 1/1,000. The closing errors were measured from the plot and an accuracy for each survey determined. The area of each fair was determined by counting the number of I mm squares.

A description sheet that contained a written description of the site, date and area of survey and quadrat clutch density data was produced for each fair. In addition, a survey tie of the site to local physical features was carried out thus enabling the fair to be accurately plotted on a large scale plan. This plotting exercise produced an unexpected result, in that Sooty Terns do not occupy the exact location on the ground in consecutive breeding seasons.

Consistency in the mapping of the fairs was maintained by using the same chief surveyor on all five expeditions.

Estimating density

Densities of eggs were estimated using a quadrat/transect sampling system. Every effort was made to place quadrat randomly. Several transects were measured across each fair. Prominent features were identified on the opposite side of the fair and used as a marker to establish the transect lines. At regular intervals (normally every 20 paces) along the line counts of eggs were made in quadrats measuring 10 metres square. One person held a vertical pole, to which was attached a cord 1.784m long, the stretched string was then used to describe a circle, and the two observers separately counted the eggs as the string passed over them. Occasionally there was a small discrepancy between the observations both of which were recorded and the mean value accepted.

AOS Expeditions

The AOS mounted five expeditions to Ascension in 1990, 1992, 1994, 1996 and 1998. Three of the expeditions, those in 1990, 1996 and 1998 were on the Island at the height of the breeding season and carried out a full census of the Sooty Terns. Each of the three expeditions carried out a survey of the fairs to determine the area of nesting birds and measured 200-500 quadrat density samples. In addition to the data collected to determine the population the expeditions ringed, weighed and measured 700 Sooty Terns, recorded predation on the colonies and measured eggs sizes. This data is been presented in separate reports. A summary of the five expeditions follows.

March 1990 Expedition

The first of the expeditions arrived in Ascension on 9 March 1990 (Nash, Hughes, and Walmsley 1991). Whilst on the Island, the team was joined by Dr Philip Ashmole, Dr Myrtle Ashmole and Dr Ken Simmons, all professional zoologists, two of whom have spent a considerable period of time studying the Ascension birds. With their guidance and support the AOS expedition was able to focus it's aims clearly and settled on the long term task of determining the breeding population of Sooty Terns. The techniques suggested by the professional zoologists were adopted by the AOS and provided the standard for future expeditions to the Island. In 1990 the expedition was fortunate to be on the Island at the height of the Sooty Tern breeding season and also fortunate in that they had the survey expertise to measure the area occupied nesting Sooty Terns.

The area surveys were carried out during the last half of the 29 day incubation period. Laying in this breeding season started on 9 February 1990 (Lowry 1990). The first chicks to hatch were seen at fair 13/90 and 14/90 on 12 March 1990 and in II/90 on 18 March 1990. Dr Philip Ashmole supported by AOS members carried out 234 quadrat samples.

Table 1: Size of the colonies and the sampling effort March 1990 season

Sub -colony	Fair Number	Grid Reference	Area(ha)	Survey Accuracy	Number of Quadrats
Mars Bay	1/90	662 173	1.35	1/30	
Mars Bay	2/90	661 172	0.15	1/120	
Waterside Fairs	3/90	682 173	5.46	1/130	78
Waterside Fairs	4/90	687 173	0.02	1/10	
Waterside Fairs	5/90	690 175	0.12	1/10	Plus 156
Waterside Fairs	6/90	691 174	0.08	1/10	Quadrats

Waterside Fairs	7/90	689 175	1.91	1/35	In fairs
Waterside Fairs	8/90	691 176	2.85	1/50	1,2 &
Waterside Fairs	9/90	692 173	0.14	1/50	4 to 14
Waterside Fairs	10/90	694 176	0.06	1/30	
Waterside Fairs	11/90	694 172	0.28	1/60	
Waterside Fairs	12/90	694 174	0.53	1/120	
Waterside Fairs	13/90	695 172	0.11	1/170	
Waterside Fairs	14/90	697 172	0.44	1/60	
Total			13.50		234

The total area occupies by Sooty Terns in the March 1990 season was 13.50 hectares, a total of 234 quadrats were measured (Table1).

July 1992 Expedition

When the expedition visited the Island on 30 June 1992 the Sooty Terns were at their night club stage (Nash, Hughes Thompson and Walmsley 1992). During this period the birds were away at sea in day light and it was impossible to estimate their numbers at night so the expedition turned it's attention to the sad remains of the previous breeding season. Eye witness account reported an unproductive season. No Sooty Terns bred at Mars Bay and the fairs were covered in deserted eggs. Two fairs that contained deserted eggs were surveyed. Sample density counts were taken at 17 randomly spaced points on the Mars Bay Fair 1/91 and the average number of abandoned eggs per square metre was calculated. These results are recorded in Table 2.

Table 2: Numbers of abandoned eggs Oct 91 - Mar 92 season

Location and Number	Grid Reference	Area in Hectares	No of Abandoned Eggs
Mars Bay No 91/1	661 172	1.67	23,600
Waterside Fair No 91/2	682173	1.47	20,700

The total number of eggs abandoned; at these two fairs was 44,300. This compared with the Mar - Aug 90 when 50,000 pairs occupied these sites. Many of these abandoned eggs were still whole. The two abandoned fairs were the two closest to human inhabitation. Although the expedition was unable to repeat the survey of 1990 some useful information was gathered. The breeding success of consecutive seasons can vary greatly and timing is vital for a successful population survey.

April 1994 Expedition

On the morning of 13 April the expedition recorded 200 Sooty Terns on the ground in one of their traditional nesting sites, by late afternoon this number had risen to 2,000 (Hughes B.J. 1994). The first eggs of the season were laid on the Waterside Fairs on the 18 April. A census of breeding Sooty Terns was carried out on the 28 April 1994. This was only 10 days after the first eggs were laid and some 32 days before the date of maximum occupation of nest sites. Five colonies had eggs at the time of the census. Estimates of densities were made by counting eggs in 17 circular "quadrates" of area 10 metre squared spaced at random. The total number of Sooty Terns in the colonies (28 April 94) was 26,000 pairs and the total area occupied was 1.85 ha. (Table 3). At Mars Bay 750 pairs were recorded.

Table 3: Size of the colonies and the sampling effort April 1994 season

Sub-colony	Fair Number	Grid Reference	Area(ha)	Survey Accuracy	Number of Quadrats
Mars Bay	1/94	661 173	0.06		Nil
Waterside Fairs	2/94	685 174	0.08		Nil
Waterside Fairs	3/94	692 173	0.14		Nil
Waterside Fairs	4/94	694 172	0.28		9
Waterside Fairs	5/94	694 174	1.16		8
Waterside Fairs	6/94	685 173	0.13		Nil
Total			1.85		17

On the 18 April a dawn to dusk sea watch was carried out on the edge of the Waterside Fairs by six members of the AOS expedition. They recorded the numbers of Sooty Terns arriving from the west at five minute intervals from 0700hrs to 1900hrs. The only significant flight path to the breeding grounds was from

the west in the direction of the sea birds feeding grounds. The lowest hourly rate of arriving Sooty Terns was 1,030 between 0700hrs and 0800hrs and the highest was 9,473 between 1800hrs and 1900hrs. The hourly number increased as the day progressed. The total for the day was 63,054 individual Sooty Terns. The expedition left before the peak of breeding activity and was unable to complete the census.

October 1996 Expedition

The expedition arrived on the Island on 30 October 1996 two days after the first chick of the breeding season hatched (Hughes B.J. 1997). The timing was perfect. Eight breeding cycles have passed since the (AOS) completed the first survey in March 1990 and determined the first estimate of the breeding population of the Sooty Tern. During the October 199.6 season the birds occupied five fairs, the largest being approximately five hectares and the smallest 0.2 of a hectare and the remaining three fairs were about a hectare each in size. The smallest fair was the first one to be occupied and the largest the last one. Chicks were hatching on the smallest fair while at the same time on the largest fair the Sooty Terns were laying claim to nesting sites. Density counts were recorded along 42 transect lines. A total of 472 quadrats containing approximately 10,000 eggs were counted. Quadrats were measured on all but the smallest fair, this fair was not sampled because it would have disturbed the young chicks and caused additional predation by Frigate Birds (Fregata aquila). The density of eggs varied from 2.40 to 0.90 eggs per square metre. The terrain occupied by the Sooty Terns dictates the density of eggs. In the most favoured areas the density of eggs can be considerably higher. Two quadrats which were not part of the random sampling process were also measured because of their unusually high density, one had a density of 6.00 and the other 6.70 eggs per square metre.

Table 4: Size of the colonies and the sampling effort November 1996 season

Sub-colony	Fair Number	Grid Reference	Area(ha)	Survey Accuracy	Number of Quadrats
Mars Bay	1/96	665 173	1.77	1/80	68
Waterside Fair	2/96	685 173	1.40	1/20	128
Waterside Fair	3/96	689 173	1.44	1/20	50
Waterside Fair	4/96	697 173	0.20	1/150	Nil
Waterside Fair	5/96	705 175	5.06	1/40	226
Total			9.87		472

June 1998 Expedition

The expedition arrived on the island on 24 June and the last member departed on 9 July 1998. As in previous years the whole Island was searched for Sooty Tern sub-colonies. One again the birds restricted themselves to their traditional sites in the SW corner of the Island. Six sub-colonies were identified and surveyed Table 5. The total area of the colony was 10.33ha. The total number of 10 metre square quadrats measured was 383. The first egg of this season was laid on 2 May 98 and the first chick hatched on 1 June 98. The census was conducted between 24 - 29 June 98 when one colony 6/98 was alive with a sea of chicks. As in previous years the Mars Bay sub-colonies (1/98 & 2/98) were the slowest to develop and there were no problems obtaining reliable egg density data. On the other hand in sub-colony (6/98) at Waterside Fair the season was much further advanced and many chicks were 2 to 3 weeks old. Although 76 quadrats were recorded on this fair the average density is likely to be suspect. The density counts were not recorded randomly across the fair because the centre of the fair contained no eggs only a multitude of chicks. Quadrats were recorded at the edge of the fair where an influx of newly arrived birds had stated laying.

Table 5: Size of the colonies and the sampling effort July 1998 season

Sub-colony	Fair Number	Grid Reference	Area(ha)	Survey Accuracy	Number of Quadrats
Mars Bay	1/98	665 176	1.26	1/100	70
Waterside Fairs	2/98	663 173	0.33	1/150	Nil
Waterside Fairs	3/98	691 175	0.88	1/40	100
Waterside Fairs	4/98	695 176	4.92	1/35	137
Waterside Fairs	5/98	694 173	0.05	1/20	Nil
Waterside Fairs	6/98	707 176	2.89	1/55	76
Total			10.33		383

It was the clear perception of those who were familiar with the Ascension Island colony of Sooty Tern that the breeding season in the summer of 1998 was the largest and most thriving colony yet observed The data collected supports these perceptions but is less than conclusive.

Analysis

The work undertaken by AOS produced detailed census information for the years 1990, 1996 and 1998. All of the data for these three years was analysed. The clutch densities were calculated by dividing the number of clutches counted in each quadrat by it's area in metres squared. Clutch densities differed among fairs and so simply multiplying the overall mean density by the total colony area would not produce precise population estimates. In addition, the frequency distribution of clutch densities in most fairs were non-normal with a strong skew towards lower values. Professional support was needed to analysis the data. The field observation were submitted to Dr Norman Ratcliffe at the RSPB who carried out a rigorous, analysis of the quadrat data. (Table 6) shows the variation in Sooty Tern nesting density (clutches per metre square) on Ascension Island among fair and years (with upper and lower confidence limits). The density values within each year are pooled for those sub-colonies that did not differ at the 0.05 significance level. The number of fairs exhibiting each mean density and their total area are also presented.

Table 6: Variation in Sooty Tern nesting densities

Year	Density	Sample Size	Lower 95% CI	Upper 95% CI	No of Fairs	Area (ha)
1990	0.51	78	0.34	0.67	1	5.46
1990	1.85	156	1.70	2.01	13	8.04
1996	1.93	118	1.72	2.14	2	3.21
1996	0.92	127	0.80	1.04	1	1.40
1996	2.52	219	2.41	2.62	1	5.06
1998	0.77	100	0.67	0.87	1	0.88
1998	2.12	307	2.03	2.23	3	9.45

Results

The breeding population size of Sooty Terns on Ascension Island between 1990 and 1998 are shown in table 7. Examination of the mean population estimates and their confidence intervals shows that the size of the breeding population has varied significantly during this period. The population sizes in 1996 and 1998 were similar and exceeded 200,000 pairs but the population size in 1990 was significantly different with 176,000 pairs. However, it does appear that the Sooty Tern population on Ascension is relatively stable, although significant fluctuations do occur around the average population size.

Table 7: Population status of Sooty Terns Ascension Island (1990- 1998)

Year	Population Size	Lower 95% CI	Upper 95% CI
1990	176 000	155 000	198 000
1996	202000	188 000	216 000
1998	207000	197 000	219 000

Values rounded to the nearest 1,000 pairs.

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Discussion

It has taken the efforts of five AOS expeditions, a total of some 200 man days and at a conservative cost of £100,000 to establish a baseline against which future population trends of Sooty Terns on Ascension Island can be measured. Sooty Terns are one of the most common seabirds in the world. Compared to the colonies in the tropical Pacific the one on Ascension is relatively small. However, it is among the largest colonies of sea birds in the Atlantic Ocean and as such is important to the biodiversity of the tropical South Atlantic. Bird populations that can be monitored regularly provide an indicators to climatic changes, food availability and predation levels. Ascension has become a focus for conservation action groups (Ashmole, N.P. Ashmole, M.J. and Simmons, K.E.L. 1994) and there are plans for the completely eradicate of feral cats that pray on the Sooty Terns (Walmsley 1991). Much has been made of feral cats predation upon Sooty Terns which when seen in the field can appear catastrophic. The surveys carried out by AOS, however, show that the population is stable and it could be argued is on the increase. The implementation of major conservation programmes based on the current population of Sooty Terns on Ascension is

unsound because no reliable trend for recent years has been firmly established. The three survey completed by AOS during the period 1990 -1998 provides a baseline for future census to establish trends. Having determined the population size at some considerable cost there is now a need for long term monitoring of the Sooty Tern to firmly identify the population trend. This work could be done by establishing a wardens post on the island or by continuing to send expeditions.

Summary

One of the main aims of the Army Ornithological Society (AOS) during the last decade was to establish the breeding population of Sooty Terns on Ascension Island. To this end five expeditions were mounted and carried out surveys on the Island in 1990, 1992, 1994, 1996 and 1998. Three of the expeditions completed full surveys of the Sooty Terns at the height of their breeding season. The colony size was measured on each occasion and clutch densities in sample quadrats recorded. The size of the colony varied from 13.5 ha in 1990 to 9.87 in 1996 and 10.33 ha in 1998. A total of 1,105 clutch density samples were measured. An analysis of all the field data was carried out by Dr Norman Radcliffe at the RSPB. The population of breeding pairs of Sooty Terns in 1990 was 176,000 with a 95% confidence level of 21,000, in 1996 the population was 202,000 with a 95% confidence level of 14,000 and in 1998 the population was 207,000 with a 95% confidence level of 12,000. The precision of the survey and the reliability of the population figure increased over the period of 8 years and 11 breeding cycles. The combination of the three surveys provide a reliable population estimate and a firm base line for future census. The aim of the society, to establish the breeding population of Sooty Terns on Ascension Island, has been achieved.

Acknowledgements

This report could not have been produced without the enthusiasm, energy and sheer hard work that members of the five AOS expeditions put into the project; to them I owe a deep debt of gratitude. My sincere thanks also goes to Dr Norman Radcliffe of the RSPB who analysed the raw field data.

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