

American Burying Beetle (*Nicrophorus americanus*) survey and reintroduction on Nantucket 2005.

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Abstract

Nicrophorus americanus is a federally listed endangered beetle once common throughout the eastern half of the United States and now surviving only in five or six population clusters in isolated or remnant habitats in seven states. For the last 12 years efforts have been taken to reintroduce the beetle to Nantucket Island, Massachusetts. To strengthen the population of *N. americanus* on the island, 324 beetles were brought to the island during the 2005 summer and provisioned with quail carcasses into 162 total broods in the Middle Moors and Sanford Farm. The larvae produced by the broods were counted to estimate the F1 generation. *N. americanus* was also trapped at each site using pitfall traps and those beetles trapped were provisioned in 76 total broods and the larvae they produced counted. The total estimated 2005 larval generation was 1,074. We performed one fall trapping interval and marked 106 newly emerging adults and five introduced adults for future use in determining winter survival rates.

This summer we also collected data on the composition and abundance of all the carrion species caught during our trapping intervals. Some 2,606 carrion beetles representing 7 species were trapped and results were similar to the 2004 data. *Necrodes surinamensis*, *Nicrophorus orbicollis*, *Nicrophorus tomentosus* and *Oiceptoma inaequale* were the most commonly trapped species.

Introduction

The American Burying Beetle (*Nicrophorus americanus*) is the largest of North America's carrion beetles (Family *Silphidae*, Genus *Nicrophorus*) and its historical range covers 35 states in the eastern temperate areas of North America (Raithel 1991). However, today, there are only scattered populations in Arkansas, Nebraska, Oklahoma, Texas, Rhode Island, South Dakota and Kansas (Threatened and Endangered Species System (TESS), M. Amaral, pers. comm.). Block Island supports the only remaining natural occurrence of the species East of the Mississippi River and the population on three study areas on the island was estimated to be 391-612 beetles between 1986 and 1990 (A. Kozol 1990; Amaral and Prospero 1999; Raithel 1991).

The last known sighting of *N. americanus* on Nantucket was in 1926 (Raithel 1991). Trapping surveys for *N. americanus* on Nantucket were conducted for three consecutive years preceding the first reintroduction and no American burying beetles were found (Combs-Beattie 1992, 1993, 1994 and Northrup 1994). In the summer of 1994, 22 pairs of beetles and four individuals were provisioned in the Massachusetts Audubon Society's Sesachacha Heathland Wildlife Sanctuary on the island (USFWS Memorandum 1998). Releases have continued during summer months up to the present and a total of 2,892 beetles have been released since 1994 (Table 1). Many of these have been reared at the Roger Williams Park Zoo in Rhode Island and some have been transferred from the Block Island population.

The summer 2005 work may be the last reintroduction effort on the island. Halting the reintroductions will offer the opportunity to monitor and evaluate the reproductive strength of the current wild population of *N. americanus* and if the population is shown to be stable the reintroduction effort may be considered a success.

Table 1. The number of introduced beetles and the number of introduced broods provisioned on Nantucket per year from 1994 to 2005. The number of broods is not necessarily half the number of introduced beetles because some broods only contained a single parent.

Year	Number of Beetles	Number of Broods
1994	48	26
1995	130	76
1996	19	12
1997	122	68
1998	38	31
1999	193	106
2000	250	125
2001	386	193
2002	637	319
2003	322	161
2004	423	214
2005	324	162
Total	2,892	1,493

Location of 2005 trapping and release sites

Beetles were released and trapped at two sites on the island of Nantucket. The eastern site, the Massachusetts Audubon Society's Sesachacha Heathland Wildlife Sanctuary is referred to as the Middle Moors. This large area of several hundred acres is composed of sandplain grasslands and heathlands, the dominant plant species being Bearberry (*Arctostaphylos uva-ursi*), Black Huckleberry (*Gaylussacia baccata*), Lowbush Blueberry (*Vaccinium angustifolium*), Scrub Oak (*Quercus berberidifolia*), Bayberry (*Myrica pensylvanica*), and Sweetfern (*Comptonia peregrina*). Provisioning sites were clustered west of a dirt road in the center of the area in low grass and bearberry and the trap line ran roughly parallel with the dirt road. The UTM coordinate for the start of the trap line was 19T 0417059 N, 4569898 E. The western site is owned by the Nantucket Conservation Foundation and is referred to as Sanford Farm. The trap line was in sandy grassland and paralleled a scrub oak forest east of the dirt road. Provisioning sites paralleled the edge of the scrub oak forest to the west of the road. The UTM coordinate for the start of the trap line was 19T 0404497 N, 4569695 E.

Trapping and Provisioning Methods

Dates of releases and trapping

There were two separate releases of beetles raised at the Roger Williams Park Zoo in Rhode Island. On 28 June 2005, 48 zoo-bred broods were provisioned in the Middle Moors and 34 broods were provisioned at Sanford Farm for a total first release of 82 broods. Quail chick carcasses were weighed and buried with a pair of beetles or a single

beetle in a shallow hole. The turf was replaced and a wire screen stapled over the area to keep out scavenging animals and birds. Thirteen days later, on 11 July, half of the broods were checked at each site and the larvae counted (see Appendix A for specific data).

The second release took place on 11 July and 40 zoo-bred broods were provisioned at each site for a total release of 80 broods. Fourteen of the broods at each site were checked and the larvae counted 13 days later on 24 July.

The total number of individual beetles brought to the island from the Roger Williams Park Zoo was 324.

We completed five trapping intervals throughout the 2005 summer, each three nights in duration. The first occurred between 21 June and 23 June, the second between 8 July and 11 July (closed traps for one night due to rain), the third between 20 July and 22 July, the fourth between 9 August and 11 August, and the fifth between 1 September and 3 September. We selected the timing of the intervals when daytime temperatures were predicted to be greater than 65F and nighttime temperatures greater than 60F with little to no precipitation.

At both Sanford Farm and in the Middle Moors we set a 400-meter pitfall trap line with 20 traps spaced about 20 meters apart to capture any roaming *N. americanus* and census the other carrion beetle populations. Trapping followed the procedure described by Kozol (1990). Each trap consisted of a 32 oz. mason jar buried with the top flush with ground level and covered with a two-sided "tent" of thick aluminum to keep out the rain and sun. Inside each jar was a plastic container with a screw-on screen lid that held several 2x2x1 inch pieces of rotted chicken. The chicken was prepared before hand in plastic containers and left at room temperature for 7-8 days. A wet 1x1x1 inch sponge was also placed in each trap to provide moisture.

For each interval, the traps were checked every morning. Captured beetles from the first four intervals were paired and provisioned after each trapping interval. We used the fifth interval to capture, notch and immediately release as many of the newly emerged adults as possible. These adults emerge between 48 and 60 days after provisioning and this interval took place 57 days after the first release and 45 days after the second release (Raithel 1991).

Results

See Appendix A for specific data organized by date.

The Middle Moors

We trapped 101 (46 males, 55 females) *N. americanus* between 4 trapping intervals, divided them into 57 broods and provisioned them near the capture site in the Middle Moors (Table 2). We exhumed 23 of these broods 13 days after provisioning and counted 70 larvae. Seven larvae were found dead and blackened. We also exhumed 34 of the 88 introduced broods provisioned on 28 June and 11 July and counted 281 larvae. Adding these values gives a total of 351 total larvae for the exhumed broods in the Middle Moors (Table 3).

Table 2. Trap data for a total of 180 trap nights in the Middle Moors and Sanford Farm during the summer of 2005. Recaptured *N. americanus* were those that had been trapped previously, paired and provisioned with carrion, and found in a trap again.

Middle Moors			
<i>N. americanus</i>	New Capture	Recapture	Total
Wild Male	15	5	20
Wild Female	19	12	31
Zoo Male	23	3	26
Zoo Female	21	3	24
Total:	78	23	101

Sanford Farm			
<i>N. americanus</i>	New Capture	Recapture	Total
Wild Male	1	0	1
Wild Female	1	0	1
Zoo Male	12	0	12
Zoo Female	13	0	13
Total:	27	0	27

Of the 57 exhumed broods, 35 (61%) were successful and these successful broods produced an average brood size of 10. A brood was considered a success if larvae of any stage were present.

Estimated and actual larvae counts

Only 57 of the 88 broods provisioned in the Middle Moors were checked and there is no data on how many larvae the unchecked broods produced. To estimate this uncounted population, we multiplied the brood success rate for each release, the average successful brood size for each release, and the number of unchecked broods for each release. We estimate that the un-checked broods produced 525 larvae. Adding this to the actual number of larvae counted for the releases and trap releases (351) gives a total F1 generation for the Middle Moors of 876 (Table 3).

Sanford Farm

We trapped 27 *N. americanus* (13 males and 14 females) at Sanford Farm, divided them into 13 broods and provisioned them near the capture site (Table 2). We exhumed three of the broods and counted zero larvae. We exhumed 31 of the 74 broods provisioned in the 28 June and 11 July releases and counted 97 larvae. The total count, therefore, was 97 larvae.

Of the 31 exhumed broods, 10 (29%) were successful and these successful broods produced an average brood size of 9.7 (Table 3). Similar to the results for the Middle Moors, we calculated these values for each individual release and for the trap releases as a group (Table 3).

Estimated and actual larvae counts

Following the same procedure used for the Middle Moors, for all the releases, we multiplied the brood success rate, average successful brood size, and the number of unchecked broods to estimate how many larvae were produced in unchecked broods (Table 3). We estimate that 101 larvae were produced. Adding this to the 97 counted larvae gives a total F1 population for Sanford Farm of 198.

Adding the F1 populations from both sites gives a total estimated population of 1,074. This is the estimated number of larvae that potentially pupated this summer In our study.

Table 3. Brood data and larval count for each release in the Middle Moors and Sanford Farm.**Middle Moors**

Date Released	# broods checked	Live Larval Count	Dead Larval Count (Death Rate)	Average successful brood size	# successful broods (Success Rate)	# Broods Unchecked	Extrapolated Count	Total Count
28 June	20	218	0	12.8	17 (85%)	28	305	523
11 July	14	63	4 (6%)	6.3	10 (71%)	26	117	180
Total	34	281	4 (1.4%)	10.4	27 (79%)	54	422	703
Trap Rel.*	23	70	7 (9%)	8.75	8 (35%)	34	103	173
Totals	57	351	11 (3%)	10	35 (61%)	88	525	876

Sanford Farm

Date Released	# broods checked	Live Larval Count	Dead Larval Count (Death Rate)	Average successful brood size	# successful broods (Success Rate)	# Broods Unchecked	Extrapolated Count	Total Count
28 June	17	92	0	11.5	8 (47%)	17	92	184
11 July	14	5	0	2.5	2 (14%)	26	9	14
Total	31	97	0	9.7	10 (32%)	43	101	198
Trap Rel.*	3	0	0	0	0 (0%)	10	0	0
Totals	34	97	0	9.7	10 (29%)	53	101	198

Total All Larvae = 1,074

* Trap releases occurred on 6/28, 7/11, 7/25, 8/10-12

Fall trapping results

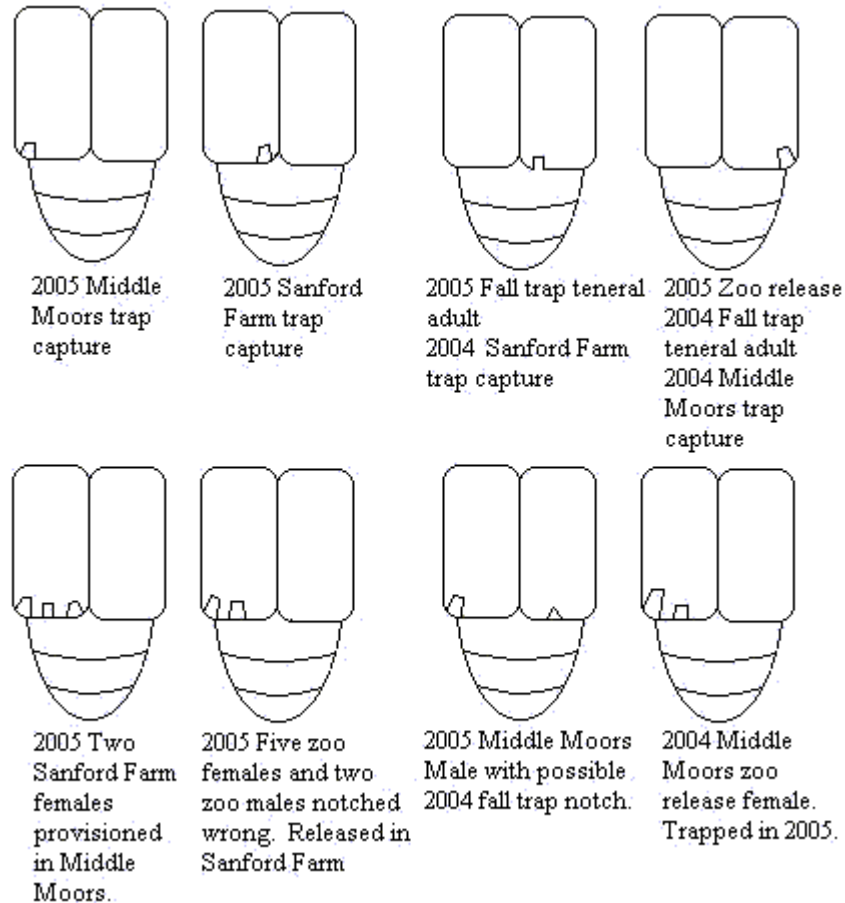
We completed one fall trapping interval starting 1 Sept and ending 3 Sept to mark as many newly emerged adults as possible. Similar to the summer of 2004, the Middle Moors showed better results than Sanford Farm with almost eight times the number of newly emerged adults (Table 4). The total number of beetles caught was 111 including 5 zoo beetles. All captured beetles at both sites were notched on the inner right elytra (Figure 1).

Table 4. Capture numbers for fall trapping interval. The interval was started 57 days after the first release and 44 days after the second release. New adults usually emerge between 48 and 60 days after provisioning.

	# Zoo Beetles		# Newly emerged		Total # captured
<i>Middle Moors</i>					
1 Sept – 3 Sept	Male	Female	Male	Female	
	1	3	47	47	98
<i>Sanford Farm</i>					
1 Sept – 3 Sept	Male	Female	Male	Female	
	0	1	6	6	13
TOTALS	5		106		111

Figure 1. Each diagram represents the elytra and abdomen of *N. americanus*. The notches were made using a cauterizing tool or small scissors. The upper row shows notching schemes used to differentiate zoo beetles from wild beetles and previously trapped beetles from newly trapped ones. The bottom row shows individually specific notching schemes due to notching error or special circumstances and the captions list how many individuals have that notching.

Key to notching schemes 2004 and 2005

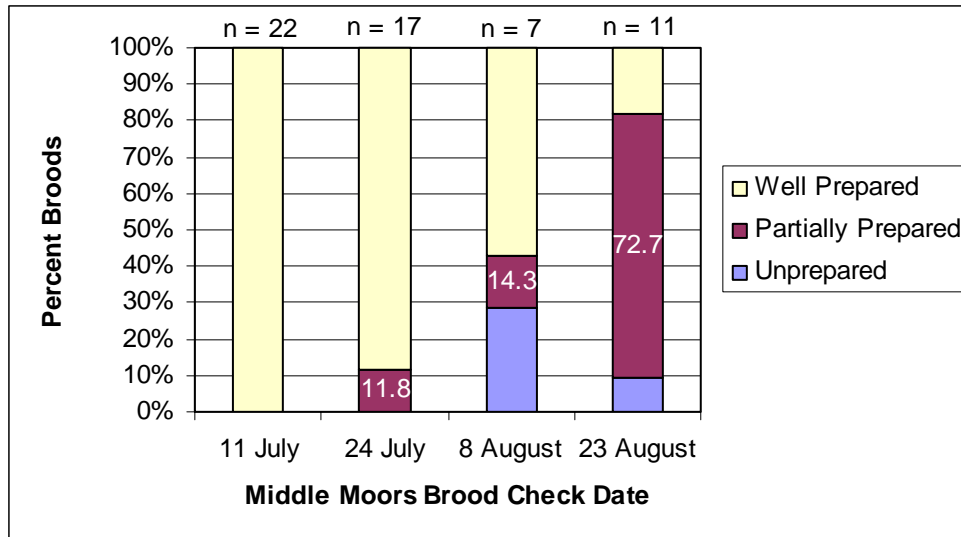


Environmental effects on results

While trapping was more successful this summer, brood provisioning was slightly less successful than it was in 2004. The average number of estimated F1 generation beetles produced per brood in 2004 was 5.52 (1,369 estimated beetles/248 broods) while this ratio for 2005 is 4.51 (1,074 estimated beetles/ 238 broods). More broods were provisioned in the Middle Moors than in Sanford Farm so there is more data available to provide an explanation for this difference at that site. Successive brood checks after each release showed a growing proportion of carcasses that were only partially prepared and a reduction of well prepared carcasses (Figure 2). The extremely dry summer with little rainfall is a possible explanation for this. As the soil got drier through the summer it may have become harder for the beetle pairs to maintain a good brood chamber and prepare the carcass properly. Only one of the 11 partially prepared carcasses exhumed in the Middle Moors was successful with three 3rd instar larvae. Several of the broods in the

Middle Moors contained dead 3rd instar larvae that were blackened and limp. They were found lying among pieces of prepared carcass. No dead larvae were found in 2004.

Figure 2. Proportions of well prepared, partially prepared, and unprepared carcasses in the Middle Moors for the four brood checks. Partially prepared carcasses increased through the summer possibly due to the dry conditions.



Sanford Farm is typically drier than the Middle Moors and the check of broods there from the second release, 11 July, showed that 43% of broods were partially prepared while 50% were well prepared (n=14). Later in the summer only three more broods were checked there and all three were partially prepared with no larvae (Table 5).

Table 5. Number and percentage of unprepared, partially prepared and well prepared carcasses at each site for each of the four separate releases. Thirteen days after each release half of the broods were checked at each site. The number of partially prepared carcasses grew as the summer progressed.

	11 Jul Release	24 Jul Release	8 Aug Release	23 Aug Release
Middle Moors				
Unprepared	0	0	2 (29%)	1 (9%)
Partially prep.	0	2 (12%)	1 (14%)	8 (73%)
Well prep.	22 (100%)	15 (88%)	4 (57%)	2 (18%)
Sanford Farm				
Unprepared	3 (18%)	1 (7%)	0	0
Partially prep.	5 (29%)	6 (43%)	3 (100%)	0
Well prep.	9 (53%)	7 (50%)	0	0

Abundances of Carrion Beetle Species

This summer we collected data on the composition and abundance of all the carrion species caught during our trapping intervals. This has great value for biodiversity study but it may also be extremely important in understanding the successes and failures

of the American Burying Beetle reintroduction. The results were very similar to 2004 data. The *Nicrophorus orbicollis* and *Nicrophorus tomentosus* populations seem to be large and prevalent on the island and were found in abundance during each interval (Figure 3 and Table 6). Their large numbers may inhibit the establishment of a strong *N. americanus* population as they compete for carrion. Though *N. americanus* prefers larger carcasses, it can still raise broods on carrion weighing as little as 35g and may be in direct competition with some of these other species (Raithel 1991).

The common carrion beetle species present on Nantucket were counted and recorded on the third night of trapping for each interval (Table 6). This was done to avoid re-counting individual beetles each morning the traps were checked. It is assumed that by the third and last night of trapping most of the carrion beetles in the area had been attracted to the trap line and that data would represent a good sample of the current population sizes.

Very similar trends were noticed at Sanford Farm between 2004 and 2005. The numbers of *N. orbicollis* peaked in June and then declined later in the summer while the counts of *N. tomentosus* and *Oiceptoma inaequale* peaked in July. *Necrodes surinamensis* dramatically increased in late summer (Figure 3). The total number of beetles peaked in July and then peaked even higher in September.

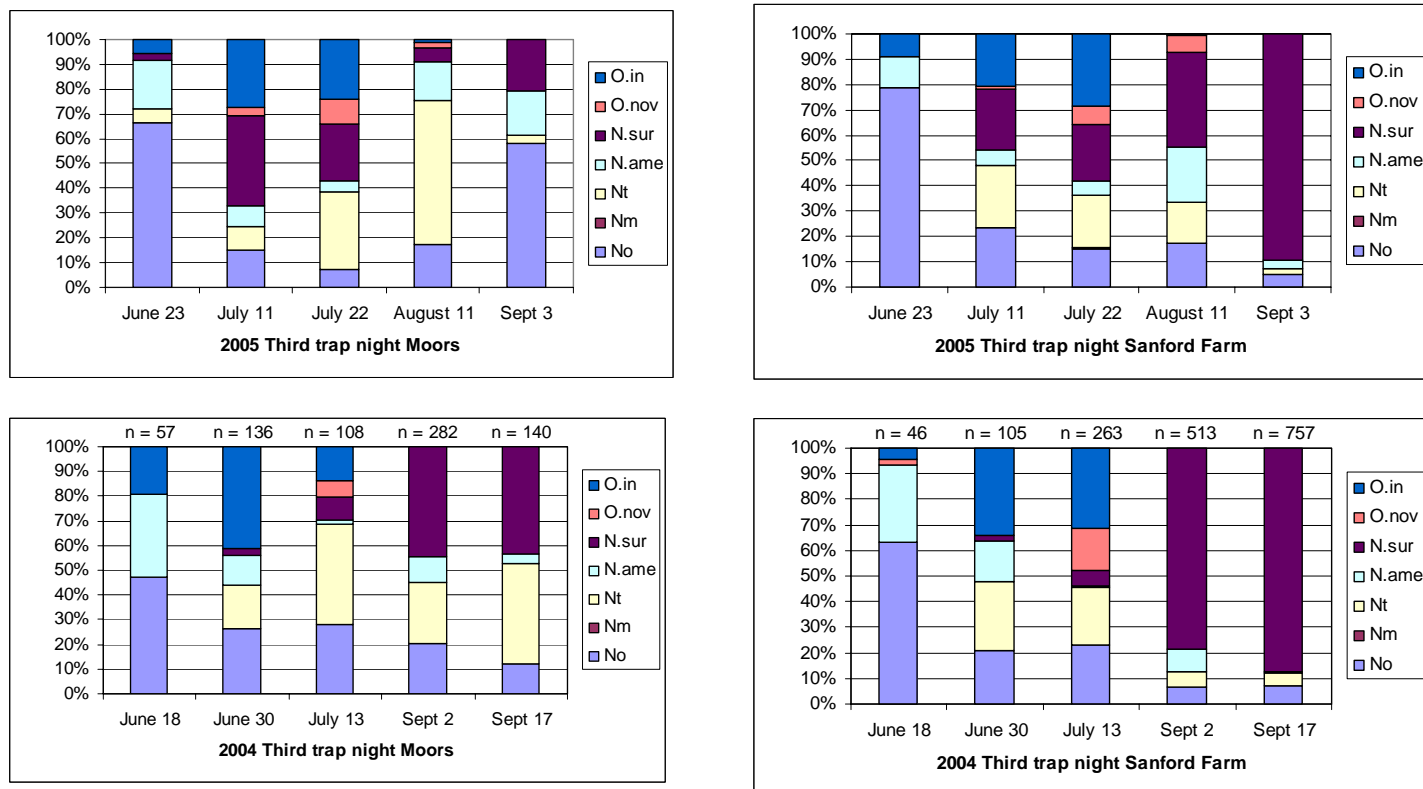
In the Middle Moors the populations did not show definite patterns and was not similar to 2004 data. The total number of beetles peaked in July but then declined (Figure 3).

Table 6 Counts for various carrion species caught in the pitfall traps on the third night of trapping during the four summer trapping intervals and the single fall trapping interval in 2005. The third night was used to best estimate the local population for each trap interval and reduce the number of individual beetles counted twice.

Species	Middle Moors	Sanford Farm	Total
<i>Nicrophorus orbicollis</i>	182	213	395
<i>Nicrophorus marginatus</i>	0	3	3
<i>Nicrophorus tomentosus</i>	239	175	414
<i>Necrophila americana</i>	89	102	191
<i>Necrodes surinamensis</i>	250	885	1,135
<i>Oiceptoma novaboracense</i>	57	45	102
<i>Oiceptoma inaequale</i>	199	167	366
Total	1,016	1,590	2,606

Various carrion species were relatively more abundant and, in general, higher numbers of beetles were caught at Sanford Farm than in the Middle Moors (Table 6 and Figure 3). *Necrodes surinamensis*, *Nicrophorus orbicollis*, *Nicrophorus tomentosus* and *Oiceptoma inaequale* were the most commonly trapped species at both sites. Very few *N. tomentosus* or *O. inaequale* were trapped early in June but their occurrence in the traps increased through the rest of the summer and virtually disappeared by fall. By the fall trapping intervals *N. surinamensis* was the most common species at Sanford Farm while *N. orbicollis* was the most common species at the Middle Moors.

Figure 3. Relative abundances for seven species of carrion beetles in the Middle Moors and Sanford Farm for 2005 and 2004. The data for Sanford Farm shows similar patterns from 2004 to 2005.



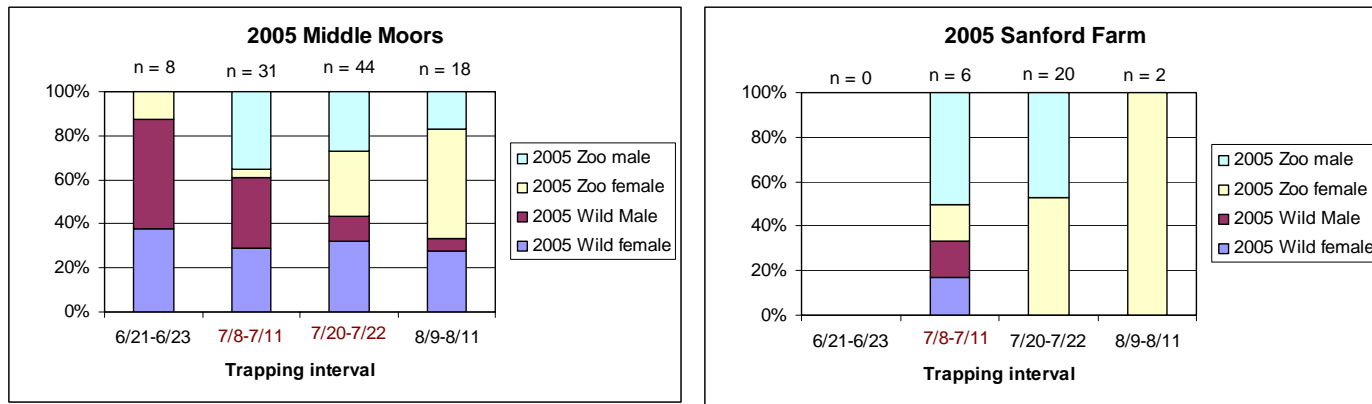
Suggestions for Future Work

Several *N. americanus* were trapped in heathland areas along Milestone Rd (the Harrier Restoration Site) and one was caught at the Windswept Cranberry Bog. They were all attracted to UV traps set out by Dr. Mark Mello and intended for moths. At least one *N. americanus* was notched, though it is not known where. In 2006 setting up a trap line closer to Milestone Rd. in addition to the trap line closer to Sesachacha Pond, may provide more information on the extent of the *N. americanus* population in the Middle Moors area and provide a better estimate of the population size.

Only two wild beetles were caught at Sanford Farm and due to the poor success of broods there this summer, trap results at that location in summer 2006 are likely to be disappointing. However, trapping should continue there for continuity.

The highest numbers of wild *N. americanus* and other species were caught in July at both sites (Figure 4). At least one trapping interval should be conducted during this month in 2006.

Figure 4. Numbers of *N. americanus* trapped during the four summer 2005 trapping intervals and the percentages of wild vs. zoo-reared and male vs. female. The highest numbers of wild beetles were trapped in July at both sites and these dates are in red. Both wild males and zoo males declined or disappeared from traps by the beginning of August.



Finally, notching schemes used in the future should take into account the possibility of catching a notched beetle from the previous summer. In the first 2005 trapping interval in the Middle Moors, a 2004 introduced adult female was trapped on the second night. This suggests that beetles from the zoo releases may be able to survive the winter and breed again the next summer. Figure 1 can be used to create an unambiguous notching method for 2006.

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Literature Cited

- Amaral, M and ML. N. Prospero. 1999. One Zoo, Two Islands, and a Beetle. *Endangered Species Bulletin* 24.
- Combs-Beattie, K. 1992. Carrion beetle (*Nicrophorus*) trapping in 3 study areas on Nantucket Island, Massachusetts, 15-18 May. Nantucket Conservation Foundation, Inc. Unpubl. Report.
- Combs-Beattie, K. 1993. A pre-release survey for the American burying beetle, *Nicrophorus americanus*, on Nantucket Island, Massachusetts. Final Report. Natural Heritage and Endangered Species Program. MA Division of Fisheries and Wildlife.
- Combs-Beattie, K. A post-release survey for the American burying beetle, *Nicrophorus americanus*, on Nantucket Island, Massachusetts. Progress Report. Natural Heritage and Endangered Species Program. MA Division of Fisheries and Wildlife.
- Kozol, A.J. 1990. Survey Protocol for *Nicrophorus americanus*. Appendix 2.
- Kozol, A.J. 1990. The Natural History and Reproductive Strategies of the American Burying Beetle, *Nicrophorus americanus*. Unpublished report prep. for USFWS. Boston University. 17 pp.
- Northrup, M. M. 1994. The American Burying Beetle (*Nicrophorus americanus*): A field investigation of its status on Coskata-Coatue Wildlife Refuge on Nantucket Island, MA. Senior Thesis. Bard College Environmental Studies Program. Annandale-on-Hudson, New York.
- Raithel, C. 1991. *American Burying Beetle Recovery Plan*. USFWS Region 5. Coordinated through New England Office USFWS, by Michael Amaral.
- Threatened and Endangered Species System (TESS). USFWS. http://ecos.fws.gov/tess_public/TESSWebpage Accessed August 13, 2004.
- USFWS Memorandum. September 22, 1998. Summary of American Burying Beetle (*Nicrophorus americanus*) From Michael Amaral, Sr. Endangered Species Specialist, New England Office (NEFO) to Supervisor, New England Field Office of Endangered Species Coordinator, Region 5.

Appendix A

Middle Moors:

Total number of broods provisioned: 145

Total number of broods checked: 57

Total number of larvae counted: 351

Provisioning Events:

28 June

- ◆ 48 broods from the Roger Williams Park Zoo were provisioned on 28 June
- ◆ 4 wild pair from the 11 June trapping interval were provisioned on 28 June
- 20 broods and 2 wild broods were checked on 11 July. 17 broods were successful, including both of the wild broods with a total of 246 larvae.
 - 202 3rd instar were counted
 - 29 2nd instar were counted
 - 15 1st instar were counted
- No second check was done
- Average brood size= 14.5(246/17) includes wild broods
- Three broods had no larvae
 - All were well prepared

11 July

- ◆ 40 broods from the Roger Williams Park Zoo were provisioned on 11 July
- ◆ 10 broods from the 7 July trapping interval were provisioned on 11 July
- 14 zoo broods and 3 wild broods were checked on 24 July. 10 broods were successful. All three wild broods failed, two had seven dead 3rd instars between them.
 - 3rd instar larvae counted = 58
 - 1st instar larvae counted = 5
 - Dead 3rd instar larvae counted = 11 (Larvae were blackened and flaccid)
- No second check was done
- Average brood size = 6.3 (63/10)
- 5 broods had no larvae
 - 2 were partially prepared

12 July

- Released 33 zoo males left over from 11 July release and recently trapped. 6 were given quail.

25 July

- ◆ 21 broods from the trapping interval were provisioned on 25 July.
- 7 broods were checked on 8 August. 4 broods were successful.
 - 3rd instar larvae counted = 28
- Average brood size = 7 (28/4)
- 3 broods had no larvae
 - 2 broods were unprepared
 - One brood was well prepared

10- 12 August

- ◆ 22 broods from the trapping interval were provisioned between 10-12 August.
 - 17 of these were single females each fertilized by one of 5 males.
- 11 broods were checked on 23 August. 2 broods were successful.
 - 3rd instar larvae counted = 14
- Average brood size = 7 (14/2)
- 9 broods had no larvae
 - 8 were partially prepared
 - 1 was unprepared

Sanford Farm

Total number of broods provisioned: 93

Total number of broods checked: 34

Total number of larvae counted: 97

Provisioning Events:

28 June

- ◆ 34 broods from the Roger Williams Park Zoo were provisioned on 28 June
- 17 pairs were checked on 11 July. Eight were successful with 92 larvae.
 - 3rd instar larvae counted = 92
- No second check was done.
- 9 broods had no larvae
 - 3 were unprepared
 - 3 were partially prepared
 - 3 were well prepared

11 July

- ◆ 40 broods from the Roger Williams Park Zoo were provisioned on 11 July
- 4 broods from the trapping interval were provisioned on 11 July.
- 14 broods were checked on 1 July. 2 broods were successful
 - 3rd instar larvae counted = 5
- Average brood size = 2.5 (5/2)
- 12 broods had no larvae
 - 6 were partially prepared
 - 1 was unprepared
 - 5 were well prepared

25 July

- ◆ 9 broods from the trapping interval were provisioned on 25 July.
- 3 broods were checked on 8 August. Zero broods were successful.
- Average brood size = 0
- 3 broods had no larvae
 - All were partially prepared

10- 12 August

No broods were provisioned at this site.