

Upland Sandpipers in New Hampshire: a Review and Prospects for Future Management



a report submitted to
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Nongame and Endangered Species Program

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INTRODUCTION

The upland sandpiper (*Bartramia longicauda*) (UPSA) requires large areas of grassland (>50 ha) for foraging and breeding (Herkert 1994, Shriver et. al 2005, Vickery et. al 1994, Walk and Warner 1999). In a 1994 survey of New England's grassland birds, Vickery et. al (1994) noted that UPSA were not detected in habitats less than 50 acres (20 ha), were infrequent in habitats less than 125 acres (50 ha) , and 50% of sites 500 acres (200) ha or greater were occupied by UPSA.

Because the natural tendency of land in New England is to produce forest, the vast areas of grassland required by UPSA do not occur without human or natural disturbance. Since the early 1900s agricultural lands in New England have been converted to other uses and been replaced with second-growth forest (Litvaitis 1993, Litvaitis et al. 1999) leading to a decline in grassland species, including UPSA. As a result, populations of UPSA have declined precipitously, and it is now listed as endangered in the State of New Hampshire. Throughout New England, UPSA remain only on sites maintained as grassland by humans: agricultural land and airports (Askins 1997, Melvin 1994). Vickery et. al (1994) found that UPSA were most abundant in south-central Maine's blueberry barrens. However, remaining farmland in New England is under constant threat of development (Shriver et al 2005), meaning that unless large scale grassland reserves are established, the last breeding habitat for UPSA in the northeast will be large airports.

Until recently (ca. 1988), UPSA had been documented in several locations in New Hampshire: farmlands in Strafford County, along the Connecticut River, Great Bay National Wildlife Refuge, and large airports (New Hampshire Wildlife Sightings

Database 2008). In recent years, however, the UPSA has been known to breed consistently in only one place in New Hampshire: Pease International Tradeport in Portsmouth. Pease International Tradeport (PSM) was formerly Pease Airforce Base, but is now a commercial airport and a New Hampshire National Guard aerial refueling wing is also stationed there. State law requires that UPSA and their breeding habitat be protected, yet safety (i.e., preventing aircraft birdstrikes) is a critical concern.

Historic breeding sites

The most recent UPSA records in New Hampshire occurred in the towns of Dover, Durham, and Rochester in Strafford County, Newington and Portsmouth in Rockingham County, Londonderry and Manchester in Hillsboro County, and Haverhill in Grafton County (Fig. 1). All sites are agricultural lands except for Newington (wildlife refuge), Portsmouth and Manchester (airports).

In Newington, the Great Bay National Wildlife Refuge has the most recent records and is in close proximity to PSM. During World War II, the area was part of Pease Airforce Base and a large portion of it was used for storing munitions. Today, the former weapons storage area (80 acres) is surrounded by a tall chain-link and barbed wire fence and access to it is restricted. Much of the area had been maintained as grassland and UPSA were last documented breeding there in 1998 (D. DeLuca, NH Audubon Society, pers. comm.).

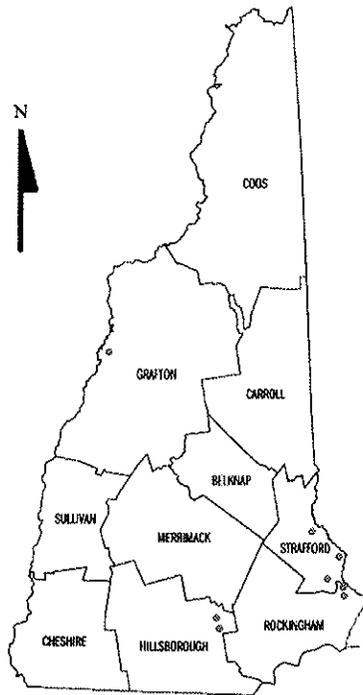


Figure 1. Historic breeding locations for upland sandpipers in New Hampshire.

Research has been conducted on the area needs of UPSA, particularly in the Midwest (Helzer and Jelinski 1999, Herkert 1994, Mong 2005, Walk and Warner 1999) but also in the Northeast (Vickery et al 1994). Figure 2 shows how the likelihood of a site being occupied by UPSA increases as its area increases. As is shown, the much smaller grassland area at Great Bay National Wildlife Refuge has about a 35% chance of being occupied by UPSA, whereas Pease Tradeport has an 80% chance of occupation due to its much larger size.

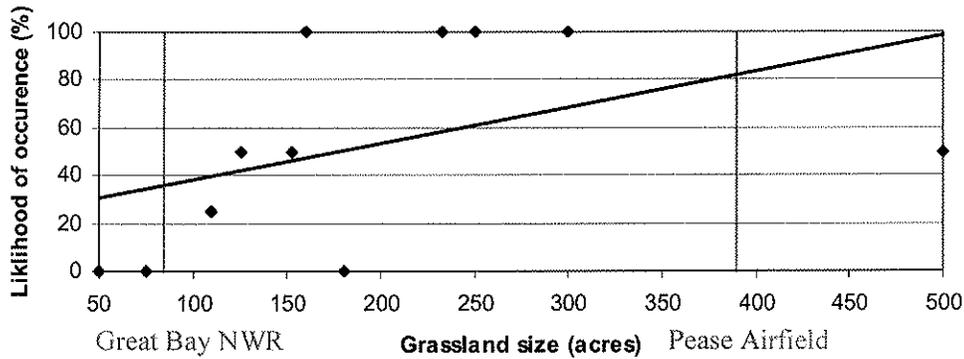


Figure 2. Grassland size and its likelihood of occupation by upland sandpipers. The areas of two sandpiper breeding areas in New Hampshire are highlighted in red. (Data points are from: Herkert 1994, Vickery et al. 1994, Helzer and Jelinski 1999, Walk and Warner 1999, Mong 2005)

Current breeding site

PSM has approximately 388 acres (155 ha) of grassland. The majority of the grassland occurs in three “infields” that lie between the runway and various taxiways (Fig. 3). Each infield is approximately 67.5 acres (27 ha). In addition to the islands, there is a long narrow stretch of grassland running along the western side of the airport known as Lowry Lane, and a field on the north and south ends. Each year UPSA breeding activity is monitored by NH Fish and Game or NH Audubon Society personnel. Airport staff is also competent in identifying UPSA and the mower operators have been instrumental in identifying nesting areas.



Figure 3. Pease International Tradeport, Portsmouth, New Hampshire and surrounding grasslands.

Preventing birdstrikes is a high priority for PSM managers. In past years, the large infield areas have been left unmowed for grassland nesting birds, but in 2010 the US Department of Agriculture Wildlife Services recommended that no grass be allowed to exceed 12 inches in height. This is to prevent the formation of seed heads that attract flocking birds such as Canada geese (*Branta canadensis*), starlings (*Sturnus vulgaris*), and turkeys (*Meleagris gallopavo*). These species are much more likely to be struck by planes than UPSA, which do not form flocks and only fly high during territorial displays. However, mowing the infields poses a threat to nesting UPSA because nests can be

crushed, abandoned, or exposed to predators. This makes finding an alternative nesting site for UPSA a priority for PSM managers and NH Fish and Game.

METHODS

Breeding surveys and nest searching

Beginning on 5/5, daily surveys for breeding activity at PSM were conducted (complete survey timeline in Appendix A). The UPSA monitor walked across the large fields recording locations of single and paired adults as well as courtship and territorial activities on a map of the airfield. These locations were compiled into one map to reveal “hot spots” and likely places for nests (Appendix B). Beginning 5/12 and through 6/15 the fields and surrounding grassland were periodically checked for nests by dragging a 100ft rope between two surveyors in an attempt to flush incubating birds from the nest. After a nest was discovered its location was taken with a handheld GPS unit and a white pin flag was placed 5 paces south of the nest, so as not to attract predators. Before a banding attempt was made on an adult, a pin from which the flag had been removed was placed directly at the nest to facilitate locating it with a spotlight at night.

Capture and banding

Adult birds were captured from the nest at night using a spotlight and dip net. If the first attempt to capture a bird was unsuccessful, the crew waited half an hour before making a second try. If the second try was unsuccessful, the banding attempt was abandoned for that day.

Once captured, adult birds and later chicks (captured with a dip net) were weighed, and the retrices (adults only), wing chord, head and culmen were measured. Each bird was banded with an aluminum #3 USFWS band and a green flag band with an

identifying code on it. Finally, a transmitter (adults: ATS model A2440, 2.0g; chicks: Lotek Biotrack PicoPip Ag337, .3g) was attached to the feathers of the back just above the uropygial gland (Mong 2005, Mong and Sandercock 2007) with gauze and super glue. While adult birds were being processed, an egg was removed from the nest and floated in a pitcher of water to determine the hatching date (Leibzeit et al. 2007). After discovery of a nest, whether banding the adult was successful or not, the nest was checked every 2-3 days until the estimated hatch date approached (Peters and Allen 2009), after which it was checked daily for a hatch.

Regular surveys began again on 7/1. By this time, however, grass in the fields had grown too high to make good observations of UPSA on the ground, so most of the survey effort was focused on the Lowry Lane area, where the grass was kept shorter.

Vegetation around nest sites was measured using protocols modified from the New Hampshire Audubon Society (DeLuca 2011).

Radio telemetry

Adults with transmitters were located during nest checking. A direction for the signal was obtained from 3 locations, and the birds' estimated location was triangulated manually using a map and compass. Chicks were located daily until the transmitters fell off by following the signal until a visual was obtained.

Regional habitat analysis

In order to better understand UPSA habitat requirements and possible alternative nesting sites in the northeast, a regional habitat analysis was conducted for New England states for which UPSA data were available (NH, MA, CT, VT). Using recent (since 2005) known locations, habitat use was first analyzed based on land cover (NH Land

Cover Dataset 2006) by determining the proportion of each land cover type at each location (Callahan, C. NH Fish and Game Dept., pers. comm.).

A moving window analysis was conducted using a 2 ha window to look for areas that met 3 criterion: an open land cover (non-forest), <80% impervious surface and <20% canopy cover (Callahan, C., pers. comm.). This analysis is based on the assumption that UPSA initially look for open areas not dominated by structures or paved surfaces when making a habitat selection. The resulting raster shows all areas in the northeast with potential UPSA habitat. This layer was converted to a shapefile so habitats could be analyzed by size.

RESULTS

Breeding surveys and nest searching

The majority of UPSA at PSM were not individually marked, making a population estimate difficult. However, it is likely that >6 pairs were present. One banded bird was observed on 5/24 walking across the runway. On 6/8 a banded bird, likely the same individual, was killed by a plane on the runway. Airport staff discovered the carcass, which was sliced cleanly in half, and reported it to the UPSA monitor, who recorded the band number. No other banded birds were observed.

Three nests were discovered by rope dragging. Nest 1 was discovered on 5/26 in the north field (Table 1), nest 2 was discovered on 6/2 in the south field, and nest 4 was discovered on 6/15 in the north field. Nest 3 was discovered on 6/6 by the mower operator.

Table 1. Upland sandpiper nests discovered at Pease Tradeport in Portsmouth, New Hampshire, in 2011.

Nest #	Nest location	Nest discovered	Detection method	Date mowed	Predated/ abandoned	Hatched	# hatched
1	43° 5.313'N 70° 49.704'W	26-May	dragging	3-Jun		20-Jun	4
2	43° 4.233'N 70° 48.824'W	2-Jun	dragging	3-Jun	22-Jun		0
3	43° 5.402'N 70° 49.543'W	6-Jun	mowing	6-Jun		23-Jun	4
4	43° 5.393'N 70° 49.778'W	15-Jun	dragging		30-Jun		0

Nest 1 and 3 successfully hatched all 4 eggs on 6/20 and 6/26, respectively. Nest 2 was predated on 6/22 by an unknown predator, and nest 4 was abandoned for unknown reasons on 6/30. Mower operators reported seeing chicks as early as 6/14.

Capture and banding

Banding attempts were made on all nests but only two were successful. Birds at nest 1 and nest 3 were banded on 6/7 and signals were received from them until the transmitters dropped off on 6/30 and 6/29, respectively. Both transmitters were recovered. Two chicks were banded in the south infield on 8/1. The transmitters fell off almost immediately so few locations were obtained.

Undiscovered nests

On 7/1 a family of two adult birds and 4 fully feathered juveniles was discovered in the Lowry Lane area (Fig. 4). This family persisted in that area for several weeks. On 7/8 an eggshell was found in an area of the north infield where no nests had been found. On 7/25 a downy chick was observed near the old nest 4. On 7/27 another downy chick was seen in the south infield near Taxiway B. Later this chick was seen with two others, and two chicks of this brood of 3 were banded on 8/1.

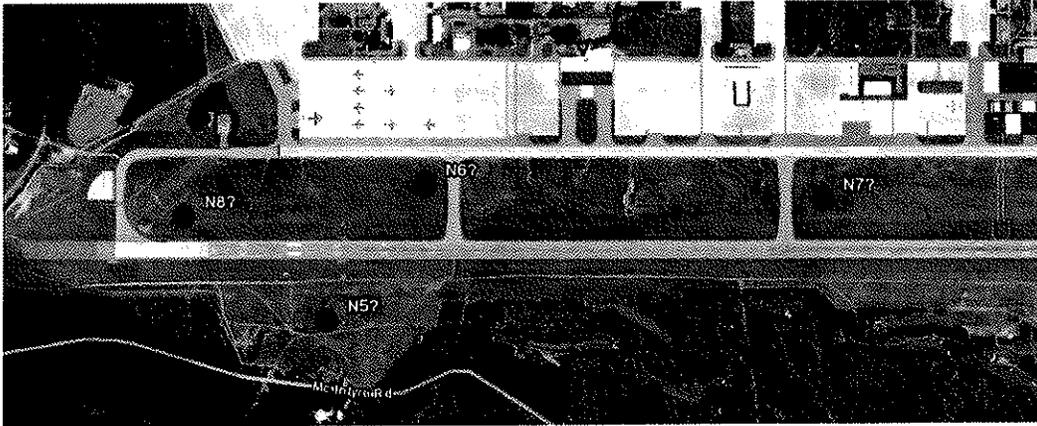


Figure 4. *Estimated location of undiscovered upland sandpiper nests at Pease Tradeport in Portsmouth, NH.*

Radio telemetry

Radio fixes were obtained for 2 marked adult birds from 6/8 to 6/29 (Fig 5). Overall, triangulating the birds was difficult. The many radio and microwave signals being broadcast around the airfield coupled with many large metal objects interfered with the signal, and possibly with the compass as well, sometimes making it impossible to get an accurate bearing. In future years it will likely be more effective to follow a signal until a visual is obtained on a bird rather than attempting to triangulate. This will also aid in determining when a transmitter has fallen off since they are not equipped with mortality sensors.

Radio fixes for 2 marked chicks were obtained from 8/2 to 8/5. One chick lost its transmitter after one day. The transmitter was recovered and on 8/3 the chick was recaptured by hand and the transmitter was reattached. The second chick lost its transmitter on the second day. That transmitter was recovered but no recapture attempt was made. The remaining chick still had its transmitter on 8/5 but had lost it by the next

visit on 8/10. On this day the chick flew during a recapture attempt so it was declared fledged and not recaptured.



Figure 5. Radio locations for two upland sandpiper adults and two chicks at Pease International Tradeport in Portsmouth, NH.

Regional habitat analysis

The average proportions of land use categories found at UPSA locations across states are shown in Figure 6. The majority of UPSA locations are in areas classified as developed open space and developed low intensity. This is because most sightings occur on airports, which are usually classified in these two categories. A combined 18% of occurrences are on agricultural (pasture and cultivated) land and only 10% occurred in

areas classified as grasslands. Only in Vermont do UPSA rely on agricultural lands (Fig. 7) particularly along Lake Champlain and the Hudson River.

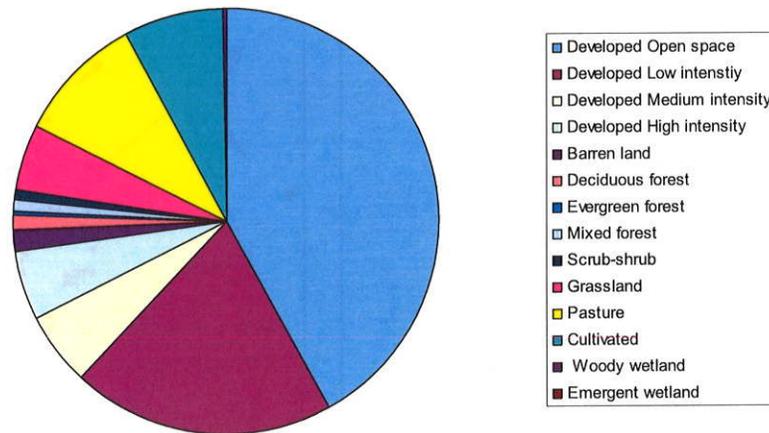


Figure 6. Proportion of each land use found at recent (since 2005) known upland sandpiper locations in VT, MA, CT, and NH.

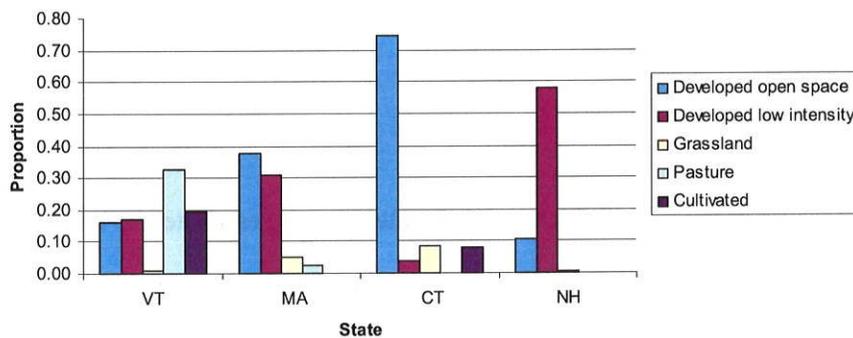


Figure 7. Land use at recent (since 2005) known upland sandpiper locations by state.

In New Hampshire, potential habitat was determined by selecting areas at least 150 acres (50 ha) in size (Fig. 8). These exist mainly in eastern Rockingham County and southeastern Strafford County, as well as along the Connecticut River. Although many large areas that appear suitable are present, they are unoccupied due to fine-scale land uses not specified in available GIS layers (e.g. golf courses and landfills). In NH, MA, and CT all known locations were on airports.

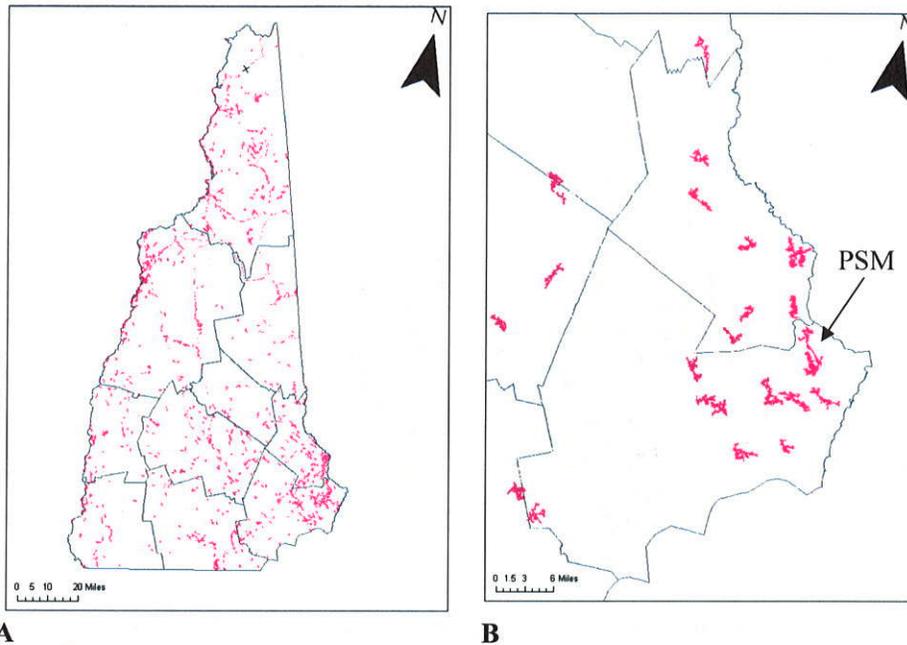


Figure 8. Potential upland sandpiper habitat patches >50 ha in New Hampshire (A) and patches >200 ha in Rockingham and Strafford Counties (B).

DISCUSSION

Current status

Because of the lack of chick sightings after known nests hatched, it is impossible to get a productivity estimate for PSM for 2011. However, it is known that 2 out of 4 discovered nests hatched, and the discovery of an eggshell in another area and 2 downy chicks for which no nest was discovered are indications of other successful hatches. Additionally, the 4 juveniles observed indicate that at least one nesting pair had 100% survival from hatching until fledging. Therefore, it is not unreasonable to assume a fairly high productivity rate was achieved this year.

Rope dragging efforts were sporadic this year because of staff shortages, so it is doubtless that some nests were undiscovered. Figure 9 shows the number of nests

discovered and suspected to exist in past years. Without a more thorough survey effort no estimates on population or productivity trends can be given.

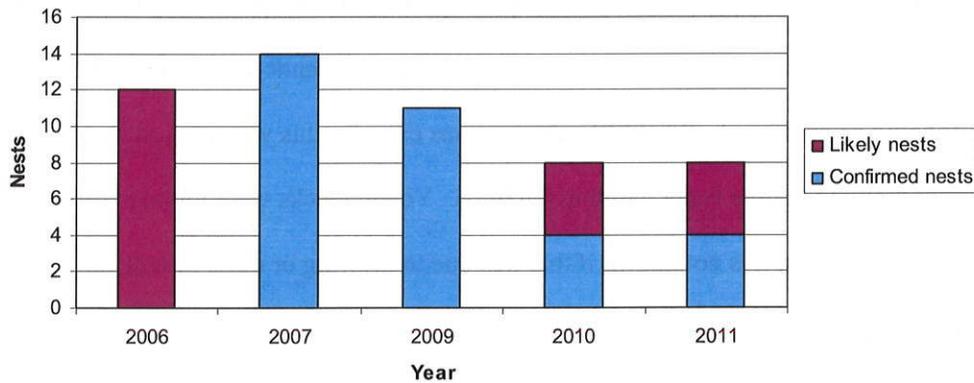


Figure 9. Number of upland sandpiper nests found and suspected to be undiscovered at Pease Tradeport in Portsmouth, New Hampshire.

Future management at Pease Tradeport

For the time being it is likely that PSM will remain the only breeding habitat for UPSA in New Hampshire. Future monitoring efforts can be streamlined with the use of a standardized data sheet (Appendix C). This will make collecting, storing, and analyzing data across years much easier. In future years a more organized, systematic, and thorough rope dragging effort should be made to get a more confident estimate of the number of breeding pairs present at PSM. Finding more nests will likely result in more adults being banded, which can in turn produce more data on chick survival and habitat use during brood rearing. A sample rope dragging schedule is given in Table 2. The appropriate time to begin dragging will vary by year; in past years nest initiation was estimated to be the third week of May (Holman 2010).

In 2011 mower operators kept a log of areas mowed and UPSA seen (Appendix D), and this data is useful for planning rope dragging and observation events.

Unfortunately the sample size of UPSA at PSM is far too small to analyze the effect of mowing and observer practices on UPSA nest success. In 2011 known nests were directly mowed over by a skilled mower operator under close supervision of the UPSA monitor. This practice did not result in any nest damage, abandonments or predations and should be continued. What little observations exist for this year suggest that the current mowing regime is not harming the birds. Young chicks were found exceptionally late in the year, but it is not known if this was due to mowing or other nest disturbances. Most young observed were fledged by early July.

Table 2. Suggested schedule for rope dragging surveys at Pease Tradeport in Portsmouth, New Hampshire.

1st dragging episode

<i>Date</i>	<i>Areas covered</i>
d	north end field and north infield
d+1	middle and south field
d+2	south end field and Lowry lane

2nd dragging episode

<i>Date</i>	<i>Areas covered</i>
d+14	south end field and Lowry lane
d+15	middle and south field
d+16	north end field and north infield

3rd dragging episode

<i>Date</i>	<i>Areas covered</i>
d+28	middle and south field
d+29	north end field and north infield
d+30	south end field and Lowry lane

Attempts to locate and observe chicks from known nests were unsuccessful, possibly because the grass in the infields was not mowed for several weeks and was too tall to observe the birds. Mowers fell behind schedule in 2010 as well (Holman 2010), raising the question of whether airport staff can possibly meet the USDA guidelines with the personnel and machinery currently available to them. PSM managers should evaluate this question with Wildlife Services and, if necessary, develop a mowing protocol that PSM's resources can handle.

Over the years, UPSA microhabitat preferences within the airfield have shifted (DeLuca 2010). In 2011 the north infield seemed to be the preferred nesting area. As in 2010 the center infield was used for courting and feeding but did not appear to be used for nesting. A large area around the VOR radar tower west of Lowry Lane is undergoing succession. Grass is sparse and weeds, forbs, and saplings are becoming abundant there. This area likely did harbor at least one breeding pair of UPSA in 2010 and 2011 but because of the many saplings it is nearly impossible to survey using the rope dragging method. PSM managers and Fish and Game personnel should decide whether it is desirable for UPSA to nest in this area. If continued UPSA occupation of this area is desired it should be mowed repeatedly in the fall to destroy the weeds and saplings and give grasses a good start in the spring. If UPSA occupation of this area is not a priority or is not desired, leaving it unmowed in the next few years will likely result in no UPSA occupying the area.

Several years of nest location data are shown in Appendix E. Over time, some patterns of repeated use have appeared (for example, the southeast corner of the north infield usually contains a nest). It is not yet clear what habitat features UPSA are finding attractive in these areas, but this data can be useful for targeted nest searching in future years.

A brief training session with the mower operators prior to the breeding season could enhance their ability to recognize UPSA nesting behaviors and prevent nests from being crushed. This training session would involve tips on identifying adult UPSA and UPSA chicks, recognizing the “broken wing” display, and instructions for finding and flagging nests that are discovered during mowing.

Alternative breeding sites

In 2009 and 2010 the NH Audubon Society conducted a survey of grasslands in New Hampshire. They found no UPSA outside of PSM in either year. The most likely alternative breeding site is at Great Bay National Wildlife Refuge. The former weapons storage area was visited twice in 2011 by the UPSA Monitor but no UPSA were observed. Furthermore, it was noted that less area-sensitive grassland species such as eastern meadowlark (*Sturnella magna*), bobolink, (*Dolichonyx oryzivorus*), and savannah sparrow (*Passerculus sandwichensis*) were also absent. This indicates that the size of the area alone may not be the reason for the absence of UPSA, but also the quality of the grassland. The monitor noted that generalist species such as Killdeer (*Charadrius vociferus*), American Kestrel (*Falco sparverius*), European starling, turkey, eastern kingbird (*Tyrannus tyrannus*), and eastern phoebe (*Sayornis phoebe*) were present. The grass has begun to succeed into forest; oak (*Quercus spp.*) stump sprouts and early-successional shrubs such as autumn olive (*Elaeagnus umbellata*) were abundant. Also, the span of grass is interrupted by large paved areas and abandoned buildings which can harbor predators.

In order for this area to be suitable for UPSA, management would be needed in the form of mowing or burning, and removal of pavement and old buildings. Even with this management, the area is small compared to PSM and is not likely to be as attractive to UPSA as the airport. Furthermore, discussions are underway to turn the weapons storage area into a refuge for the state endangered New England cottontail (*Sylvilagus transitionalis*). If this occurs, the area would not be suitable for UPSA because the cottontails require shrubland, not grassland, and dividing the area between the species

will mean that there is not enough space for either. Therefore, the Thomas field area of the refuge has been suggested as an alternative.

The Thomas fields are small compared to PSM (approx. 24 acres) and would require some management to be suitable for UPSA. The fields are becoming overgrown and are full of milkweed (*Asclepias spp.*), goldenrod (*Solidago spp.*), and other undesirable native plants as well as highly invasive glossy buckthorn (*Rhamnus frangula*) (Fig. 10). In addition, the fields are interrupted by stands of trees and hedgerows, which increase edge and promote predators. During a visit in late summer the UPSA monitor noted bobolink fledglings and eastern meadowlarks, indicating that the area has potential as grassland habitat. However, shrubland species such as brown thrasher (*Toxostoma rufum*) and song sparrow (*Melospiza melodia*) were also present.



Figure 10. Looking north across the Thomas fields area of Great Bay National Wildlife Refuge in Newington, New Hampshire. Plants undesirable to grassland birds such as milkweed (white circle), goldenrod (yellow circle) and glossy buckthorn (green circle) should be removed.

In order to be made suitable for UPSA, standing trees and hedgerows must be removed. Glossy buckthorn and other invasive plants should be treated with herbicides to prevent recurrence after mowing. Mowing should take place several times a year from late summer through fall to prevent milkweed, goldenrod, and woody plants from becoming established. Seeding with native grasses may also be necessary. If cooperation from the abutting landowner can be achieved, this would nearly double the area of habitat available (up to 44 acres) and makes the site more likely to attract UPSA from the nearby airport (Fig. 11). However, even given these management steps, the nearby PSM remains a much larger and likely more appealing habitat choice to UPSA. Therefore, discouraging UPSA from nesting at the airport through increased mowing or other disturbance may be needed.

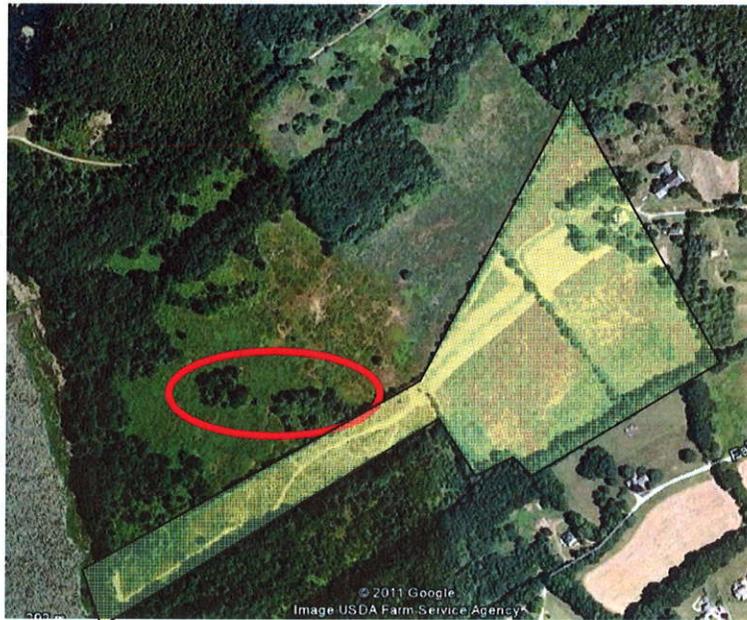


Figure 11. The Thomas fields area of Great Bay National Wildlife Refuge, Newington, New Hampshire. In order for these fields to be suitable to upland sandpipers, stands of trees (red circle) and hedgerows must be removed. It would also be desirable to acquire cooperation from the abutting landowner (yellow) thereby nearly doubling the size of the site.

The regional habitat analysis highlighted other potential habitat patches, even some that rival PSM in size, but while these areas meet the UPSA's spatial habitat requirements, fine-scale land uses are preventing them from nesting there. Therefore, cooperation would be needed from landowners and this could be very difficult, costly, or impossible to get. For example, several identified areas were golf courses or landfills. While these are grasslands, human activity makes them unsuitable nesting sites. Golf courses are frequently mowed, watered, fertilized, and have heavy human traffic. Landfills are noisy and heavy machinery is often present, as well as large flocks of gulls and other scavengers. Potential patches identified by the model would need to be examined on the ground to determine if its current use could be compatible with UPSA requirements. For example, an area currently used as a pasture would be more easily converted to UPSA habitat than a golf course. It appears that the limited human traffic and alteration (other than mowing) of airports is attracting UPSA to nest there and it is likely that these habitats will continue to be the primary breeding grounds for UPSA in the northeast unless large patches of grassland can be conserved for grassland birds.

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APPENDIX A

2011 Breeding and Survey Timeline

April

20 first survey of grasslands, several pairs observed

May

5 daily surveys begin

12 first rope dragging event, north infield

18 dragged center infield

20 dragged north infield

24 banded bird observed crossing runway

26 dragged north end field and infield, Nest 1 with full clutch in north infield

27 dragged center infield

31 dragged west of Lowry Lane, unsuccessful banding attempt on Nest 1 bird

June

2 dragged south infield and west of Lowry Lane, Nest 2 with 3 eggs in south infield, unsuccessful banding attempt on Nest 1 bird, egg floated

3 Nests 1 and 2 mowed, Nest 2 clutch complete

6 Nest 3 found by mower operator in north end field, dragged west of Lowry Lane

7 Nest 1 and 3 adults banded, egg floated in Nest 3

8 radio triangulations begin, banded bird killed on runway

13 predicted hatch date for Nest 1

15 dragged north infield, Nest 4 with 1 egg

20 Nest 1 hatch, mower operator reports seeing chicks since 6/14

21 unsuccessful attempt to band chicks, predicted hatch date for Nest 3

22 Nest 2 predated

23 Nest 3 hatch

30 Nest 4 abandoned, recovered transmitter from Nest 1 adult

July

1 recovered transmitter from Nest 3 adult, daily surveys for chicks begin, 4 fully feathered juveniles near VOR tower

8 found eggshell from undiscovered nest in north infield

15 daily surveys for chicks end

25 downy chick observed near old Nest 4, flocks of 9 and 5 seen, possible beginning of migration

27 downy chick observed in south infield

August

1 chicks banded in south infield

2 transmitter lost

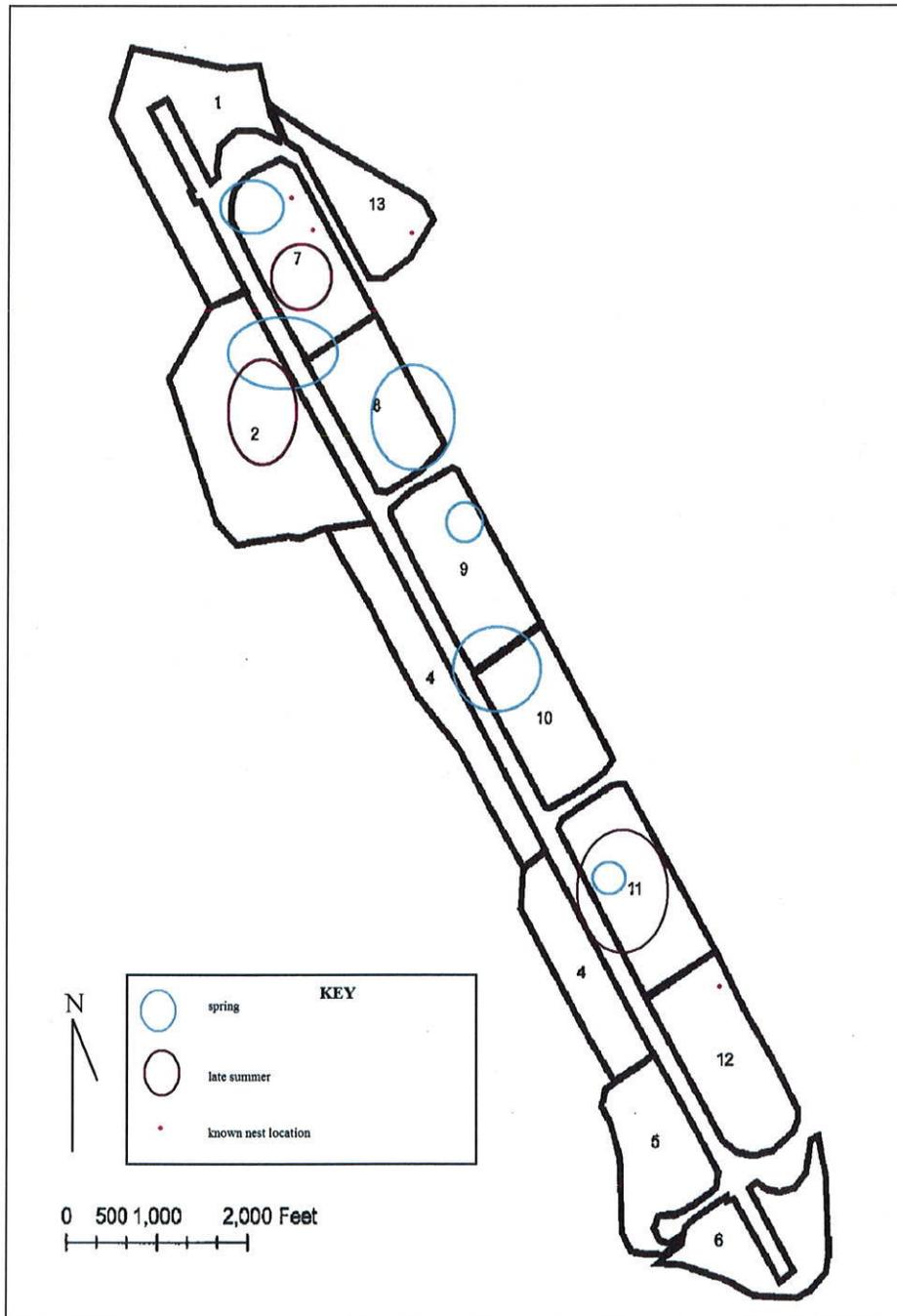
3 2nd transmitter lost, 1 chick re-transmitted

5 transmitter lost

10 2nd transmitter lost; chick flew during recapture attempt

APPENDIX B

Compilation map of UPSA observations



APPENDIX C

Standardized Observation Form

Date _____ Observer _____ Weather: Sky _____

Wind _____

Temp _____

Time _____

Number of birds _____

Circle one: Single bird

Breeding pair

Parent(s) with brood

Migrating flock

Behavior Observed _____

Vocalizations heard _____

Location on airfield: Wildlife Sector 1 2 3 4 5 6 7 8 9 10 11 12 13

Movement and direction _____

Other notes: _____

APPENDIX D

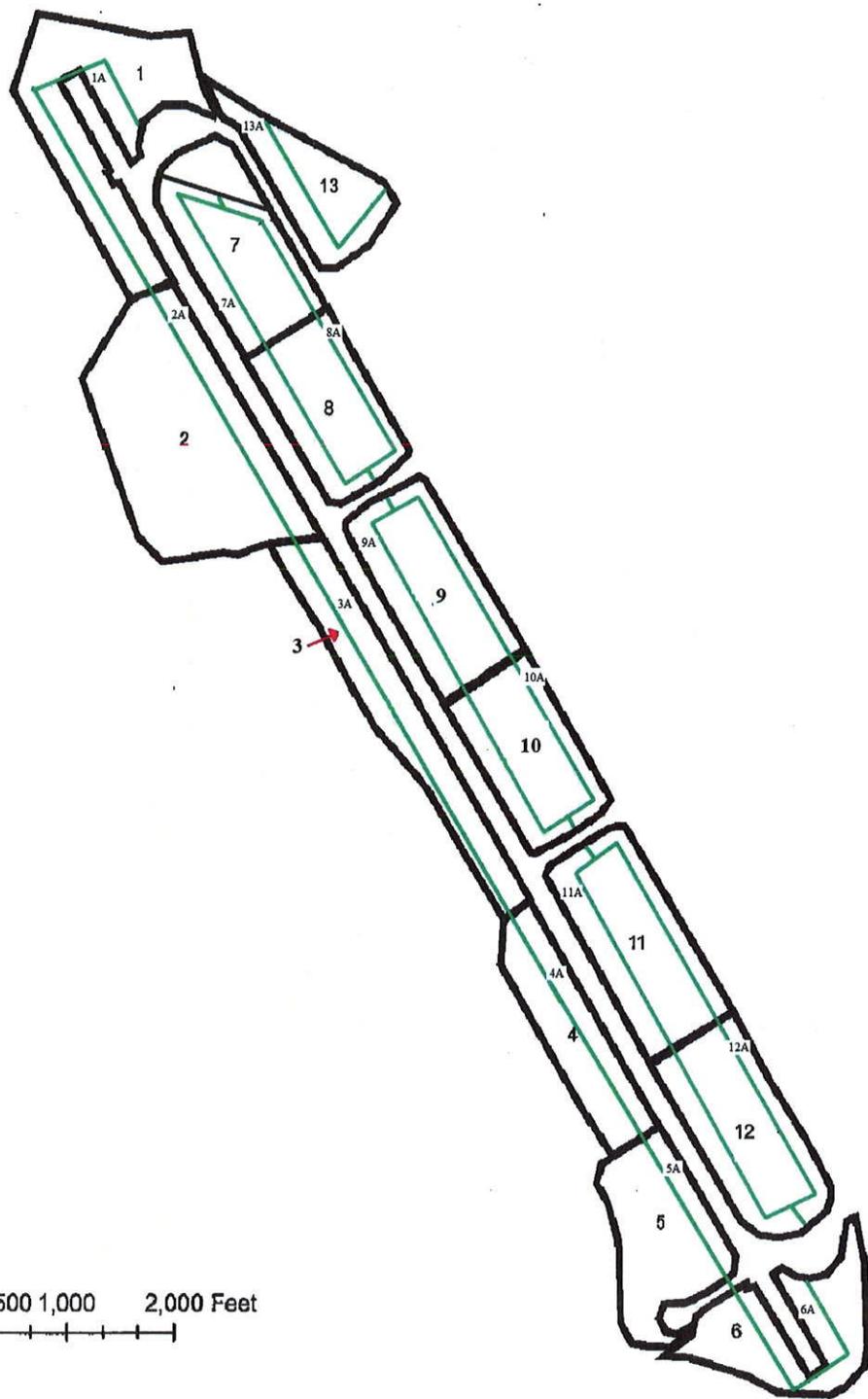
Mower Operators' Log

Sector*	Dates Mowed														
	May														
	3	4	5	9	10	11	12	13	17	18	19	20	26	27	31
1						X								X	X
2						X								X	
3					X	X								X	
4					X	X								X	
5														X	
6															
7															
8															
9											X				
10											X				
11															
12															
13															
1A							X						X		
2A				X	X							X	X		
3A				X								X	X		
4A				X								X	X		
5A				X									X		
6A				X									X		
7A		X						X							X
8A		X							X				X		
9A	X	X						X							X
10A			X						X	X			X	X	
11A	X						X	X							X
12A			X			X	X		X					X	
13A					X	X				X				X	

Sector*	Dates Mowed															
	June															
	1	2	3	6	7	8	13	14	15	16	17	21	27	28	29	30
1			X	X		X					X					
2					X											
3				X	X						X					
4	X			X							X					
5			X	X												
6		X														
7	X	X	X						X							
8	X	X	X						X							
9		X											X			
10		X												X		
11	X			X	X											
12	X			X	X											
13						X										
1A										X	X					
2A										X	X	X				
3A										X						
4A										X						
5A										X						
6A										X						
7A								X								
8A							X								X	
9A									X							
10A							X								X	
11A									X							
12A							X									X
13A				X												

Sector*	Dates Mowed							
	July							
	5	6	7	11	12	20	25	26
1						X		
2								
3								
4					X			
5					X			
6				X	X			
7							X	X
8							X	X
9			X					
10			X					
11			X					X
12								X
13	X							
1A				X	X	X		
2A				X	X			
3A				X	X			
4A				X				
5A				X				
6A				X				
7A		X						
8A								
9A		X	X					
10A								
11A			X					
12A								
13A								

* Note: see image below for diagram of wildlife sectors.



APPENDIX E

Historic Nest Locations at PSM



