

**Results of Bat Inventories at
Ocmulgee National Monument
and Proposed Expansion Area
2015-2016**

National Park Service
Southeast Coast Inventory and Monitoring Network
Piedmont South Atlantic Coast Cooperative Ecosystem Studies Unit
Agreement #H5000085041

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Project Objective: To cooperate with the University of Georgia to conduct updated bat inventories at Ocmulgee National Monument.

BACKGROUND AND SCOPE OF WORK

In 1999, the National Park Service (NPS) initiated a long-term ecological Inventory and Monitoring program to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition. The overarching purpose of this program is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems.

Natural resource inventories are extensive point-in-time surveys to determine the location or condition of a resource, including the presence, class, distribution, and status of biological resources such as plants and animals, and abiotic resources such as air, water, soils, landforms, and climate. Inventories may involve both the compilation of existing information and the acquisition of new information.

The primary purpose of natural resource inventories is to assess and document the current condition and knowledge of natural resources in the parks. Inventories allow comparison of existing conditions to the natural or desired state of parks and establish a solid baseline for making scientifically sound management decisions and long-term monitoring plans that ensure the future health of the parks.

Bat inventories were completed at OCMU in 2005 using a combination of acoustic sampling and mist netting, during which 7 species (all those that were expected) were documented during 16 trap nights (Loeb 2006). The bat community was found to be diverse despite its location in an urban setting, likely due to its location along the Fall Line. Because of the diversity of habitats, including both pine and bottomland hardwood forests, it is expected that both foraging and roosting habitats are present at the park.

In response to the recent detection and spread of White-nose Syndrome (WNS) among bat species, NPS has service-wide management interest in identifying populations at risk within potentially-affected NPS park units. To date WNS has not been detected at OCMU, but the disease has expanded southward into GA in recent years (see below). As a result, in 2013 OCMU received funding to update bat inventories.

This project implementing summer bat inventories aimed to document presence and an index of relative abundance of bat species within the existing monument property and expansion area. This project also involved establishing monitoring routes to be included in routine bat monitoring efforts being conducted by the state.

Table 1. Bats of Georgia including species codes and state and federal status.

CODE	Scientific Name	Common Name	US Status	GA Status
CORA	<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared bat		Rare
EPFU	<i>Eptesicus fuscus</i>	big brown bat		
LANO	<i>Lasionycteris noctivagans</i>	silver-haired bat		
LABO	<i>Lasiurus borealis</i>	Eastern red bat		
LACI	<i>Lasiurus cinereus</i>	hoary bat		
LAIN	<i>Lasiurus intermedius</i>	Northern yellow bat		Species of Concern
LASE	<i>Lasiurus seminolus</i>	seminole bat		
MYAU	<i>Myotis austroriparius</i>	Southeastern myotis		Species of Concern
MYGR	<i>Myotis grisescens</i>	gray myotis	Endangered	Endangered
MYLE	<i>Myotis leibii</i>	Eastern small-footed myotis		Species of Concern
MYLU	<i>Myotis lucifugus</i>	little brown myotis		Species of Concern
MYSE	<i>Myotis septentrionalis</i>	Northern long-eared myotis	Threatened	Threatened
MYSO	<i>Myotis sodalist</i>	Indiana myotis	Endangered	Endangered
NYHU	<i>Nycticeius humeralis</i>	evening bat		
PESU	<i>Perimyotis subflavus</i>	tri-colored bat		Species of Concern
TABR	<i>Tadarida brasiliensis</i>	Brazilian free-tailed bat		

METHODS AND RESULTS

Roost Searching

One of the goals of this project was to search for Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) roosts in hollow trees in the bottomland hardwood forests on the park and expansion area. Because a Rafinesque's big-eared bat had been captured in the past, we thought it was possible there were roosting sites on the park. Originally, we had planned to search the wettest areas of the park most likely to contain the largest trees with a randomized transect system. However, when we began our work we realized that there were a low number of available roost trees. We decided that transects were not appropriate and began targeting potential roost trees and searching manually. We focused on the areas identified as wetlands on the National Wetland Inventory maps and the areas that the park staff suggested may have some remnant trees.

No roost trees were identified during the two years of the survey. No Rafinesque's big-eared bats were captured during mist net surveys so we were unable to track any bats to roosts using radio-telemetry. Though no roost trees were identified, it is likely that some are present on the

expansion area. Though all the available areas were searched, it is impossible to search every tree and it is possible roosts may have been missed. However, the majority of the trees in the area are too immature to serve as roosts. Over time if the forest matures, more roosts will become available. The bottomland hardwoods swamps on Ocmulgee WMA are more extensive and include larger areas of mature trees. That site provides a critical protected area for the Rafinesque's big-eared bats and Southeastern myotis (*Myotis austroriparius*). Most likely this area serves as the primary roost site for these species and they may use the park expansion area as an alternate roost area. It's also likely that they use the park area for foraging as they move up and down the Ocmulgee River.

Mist-netting

Mist netting is the most commonly used method for capturing bats traveling and foraging across the landscape, and can provide useful demographic parameters along with confirmation of species-presence in an area (Loeb et al. 2015). Standard mist netting techniques (Gardner et al. 1989) were used throughout the survey. Sites were selected in areas where a high level of bat activity was expected with mist nets placed over roads, trails, streams and other corridors. In general, nets were erected around sunset and taken down before 2 A.M EST. Captured bats were identified, weighed, measured and checked for signs of WNS. Mist netting was completed over 5 nights in 2015 and for 10 nights in 2016. In total, 19 bats were captured over the 15 nights of netting. A summary of the capture locations and results are below (see Figs 1 & 2).

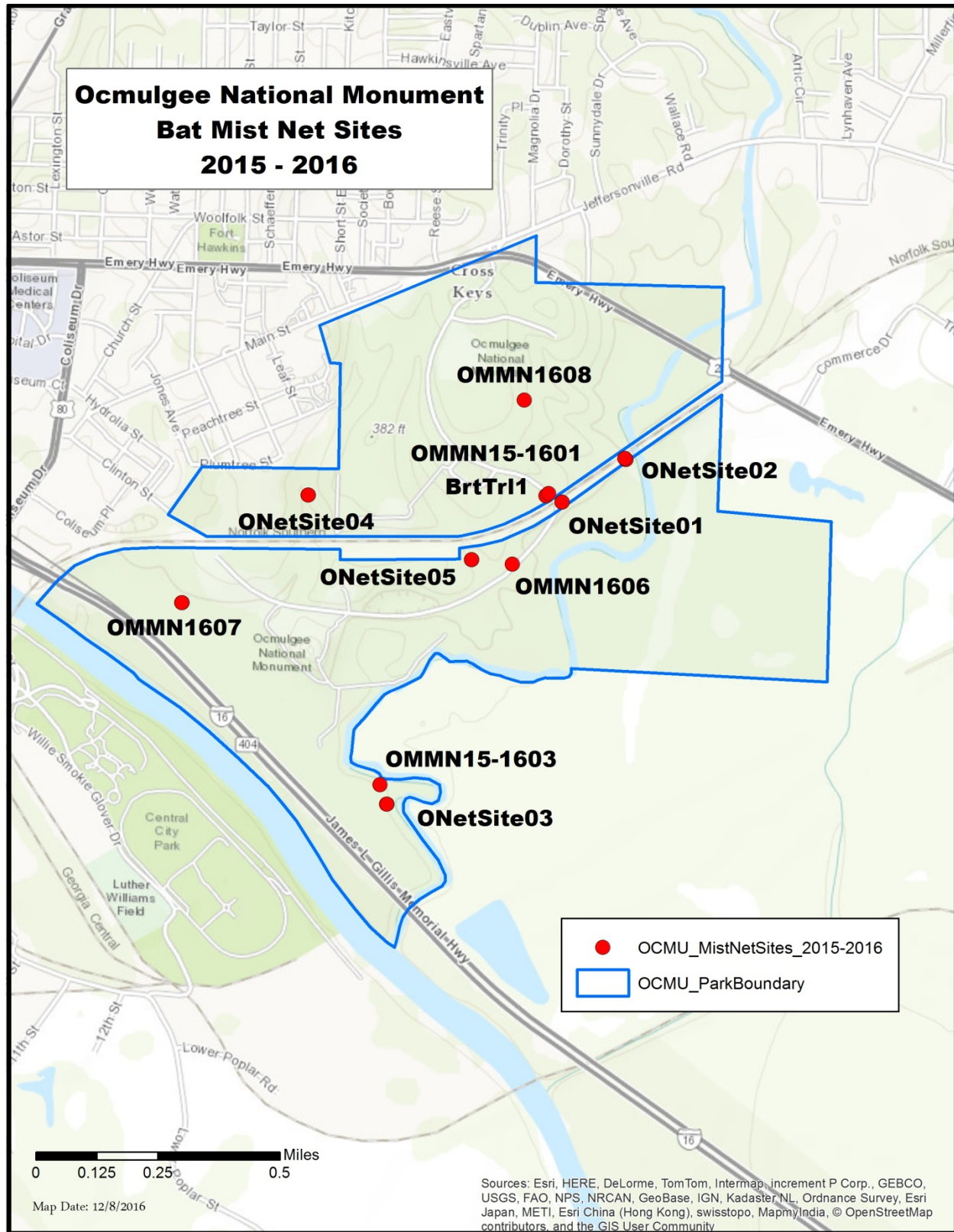


Figure 1. Bat mist net locations at OCMU during 2015-2016.

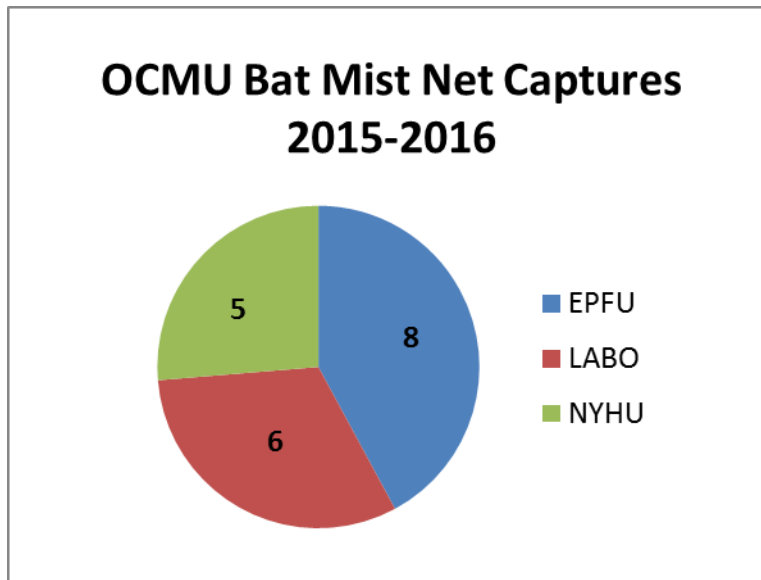


Figure 2. Bat mist net captures at OCMU during 2015-2016.

Stationary Anabat Units

Foraging bats are difficult to study due to their small size and volant, nocturnal nature. Because trapping bats is both labor intensive and biased towards species or individuals that do not detect the traps or nets (Berry et al. 2004, Larsen et al. 2007), acoustic methods are often employed for foraging studies. Generally, bat activity is measured in the number of files or passes recorded (Hayes 2007). Because it is not possible to discriminate between several bat passes made by a single bat flying repeatedly through a sampling area versus several bats each making a single pass, and because some species may be indistinguishable from others due to similar call characteristics or difficult to record (Fenton 1982, Lacki et al. 2007), bat activity should be used as a relative term for assessing bat use (traveling and foraging). While bat passes do not allow a direct estimate of population densities, this method does provide a relative measure of bat activity in an area and allows for comparisons to be made between sites over time (Adams et al. 2012).

From mid-June through mid-July in 2015 and 2016 bat presence and activity was acoustically monitored at a total of 9 sites within the OCMU park boundary and another 3 sites within the Cherokee Brick expansion boundary (Figure 3). AnaBat Express detectors (Titley Scientific, Brendale, Australia) were housed in a plastic weatherproofing case and mounted above 1.5m on trees with microphones oriented away from vegetation or other obstructions (Britzke et al. 2010). Detectors were deployed at each sampling point to record bat echolocation sequences for a minimum of 5 nights, resulting in 120 total detector nights. Detectors used a built-in GPS feature to program sunset and sunrise times for automatic night recording. Sampling on nights with moderate to heavy rain was avoided when possible.

Bat echolocation call files were identified to species using Echoclass v. 3.1. bat call analysis software (Eric Britzke, ERDC) with the Species Set 1 classifier and a minimum of 3 call pulses. All

passes identified as possible *Myotis* spp. were manually examined to verify accuracy of the identification using AnaLookW v. 4.2f software (Titley Scientific, Columbia, MO). Bat activity was recorded in all 12 OMCU sites sampled between 2015 and 2016, but the level of activity (mean number passes/night) varied by site (Table 2). In addition to the verified *Myotis* spp. passes that were grouped due to similarity of call characteristics, 6 other species were identified (Table 2). Eastern red bats (*Lasiurus borealis*) and big brown bats (*Eptesicus fuscus*) were the most commonly recorded species identified. *Myotis* spp. were rarely recorded, with calls only documented during the second year of sampling at 4 sites. Based on call characteristics and species-range parameters, the majority of *Myotis* passes detected were most likely Northern long-eared (*M. septentrionalis*) and Southeastern species. In spite of Rafinesque's big-eared bats being captured in the 2005 bat inventories completed at OCMU, Rafinesque's big-eared bats are unable to be identified using Echoclass software as they are not included in the Echoclass Species Set classifiers. Additionally, the low frequency calls of Rafinesque's big-eared bats are difficult to record acoustically (Loeb et al. 2011). Therefore, further manual vetting may be necessary to determine possible presence of this species in the park. A summary of 2015 and 2016 acoustic sampling locations and results are below (see Table 2 & Figure 4).

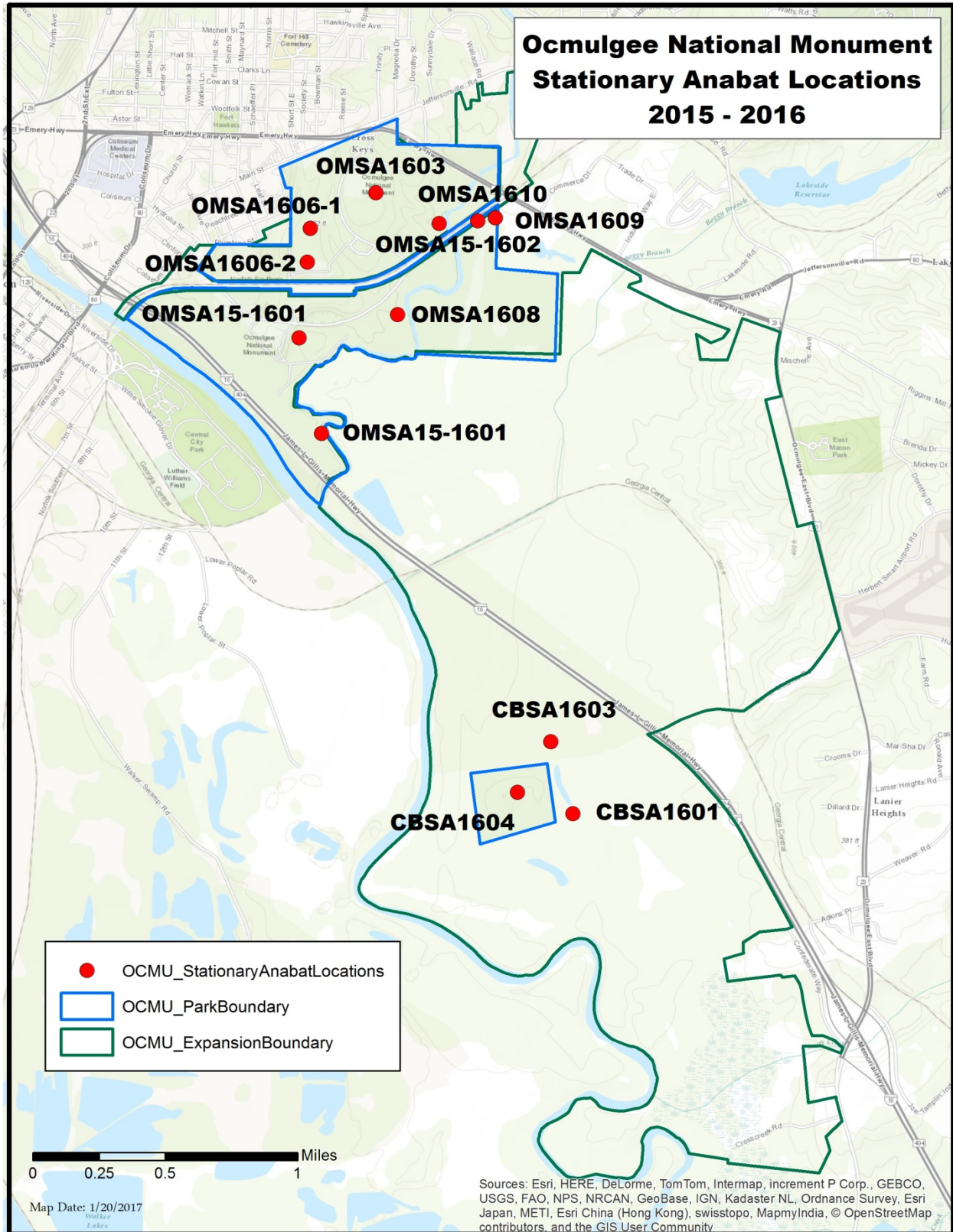


Figure 3. Stationary Anabat locations at OCMU during 2015-2016.

Table 2. Mean activity (passes/detector night) by species in various sampling sites at OCMU in June-July 2015 and 2016. *EPFU* *Eptesicus fuscus*, *LANO* *Lasionycteris noctivagans*, *LABO* *Lasiurus borealis*, *LACI* *Lasiurus cinereus*, *MYSP* *Myotis species*, *NYHU* *Nycticeius humeralis*, *PESU* *Perimyotis subflavus*, *UNKN* unknown

Site Sampled	Sampling Dates	EPFU	LANO	LABO	LACI	MYSP	NYHU	PESU	UNKN
OMSA15-1601	6/19/15-6/25/15	85	21	72	61	0	9	41	443
OMSA15-1602	6/26/15-7/01/15	1	0	2	0	0	0	0	154
OMSA15-1605	7/2/15-7/7/15	4	0	23	0	0	0	1	334
OMSA15-1601	5/20/16-5/24/16	17	41	153	262	0	5	12	377
OMSA1606-1	5/25/16-5/29/16	9	3	26	5	0	3	0	78
OMSA1606-2	5/25/16-5/29/16	23	18	17	25	0	2	0	120
OMSA15-1602	6/13/16-6/17/16	25	3	14	4	0	1	0	96
CBSA1601	6/15/16-6/18/16	45	1	48	4	1	16	3	186
OMSA1603	6/18/16-6/22/16	142	4	137	5	0	4	2	348
OMSA15-1605	7/13/16-7/17/16	0	0	1	0	1	0	0	730
CBSA1603	7/27/16-7/31/16	3	0	12	0	3	1	3	51
CBSA1604	7/27/16-7/31/16	55	1	127	1	7	6	17	283
OMSA1608	7/27/16-7/31/16	47	2	47	1	0	1	1	156
OMSA1609	7/27/16-7/31/16	61	1	47	1	0	1	2	127
OMSA1610	7/27/16-7/31/16	9	2	31	6	0	2	20	210

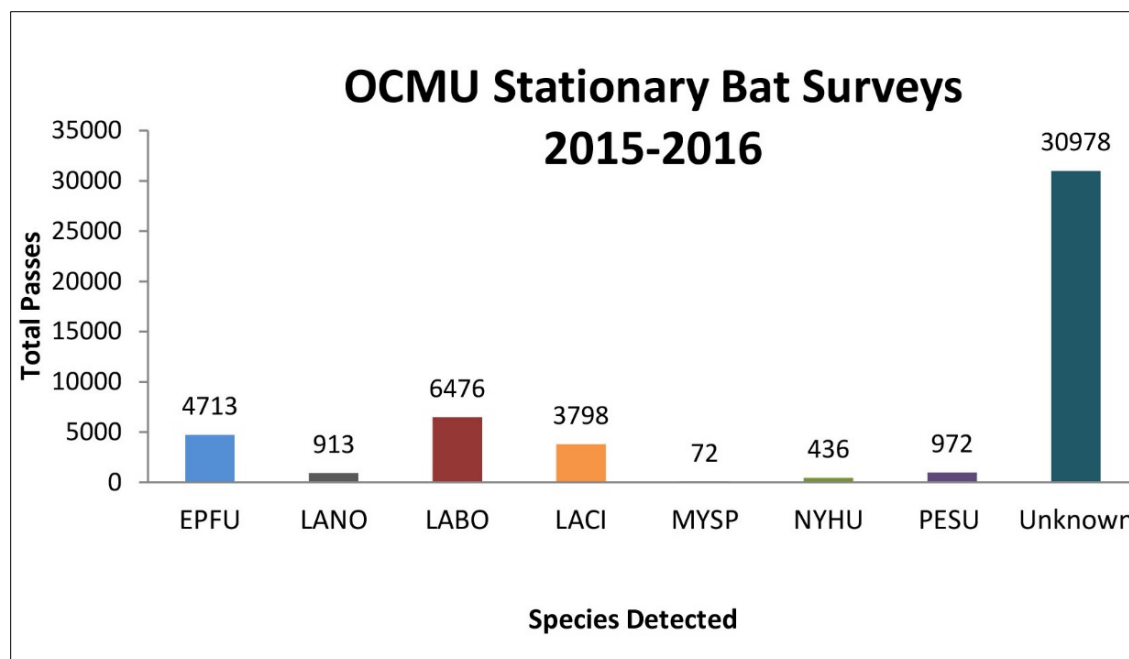


Figure 4. Total stationary acoustic passes recorded at OCMU in June-July 2015 and 2016 by species.

Mobile Transect

One mobile transect was conducted in May 2016 with an Anabat SD2 bat detector (Titley Electronics, Ballina, Australia) fixed to the roof of a vehicle, which was then driven slowly (< ~10 km/h) along the predetermined OCMU route. The transect commenced 45 min after sunset.

Bat echolocation call files were identified to species using Echoclass v. 3.1 bat call analysis software (Eric Britzke, ERDC) with the Species Set 1 classifier and a minimum of 3 call pulses. Manual examination using AnaLookW v. 4.2f software (Titley Scientific, Columbia, MO) was not required as no passes were identified by Echoclass software as possible *Myotis* spp. Six other species were identified from the OCMU mobile route (Table 3). Eastern red bats and big brown bats were the most commonly recorded species identified. A summary of 2016 mobile transect location and results are below.

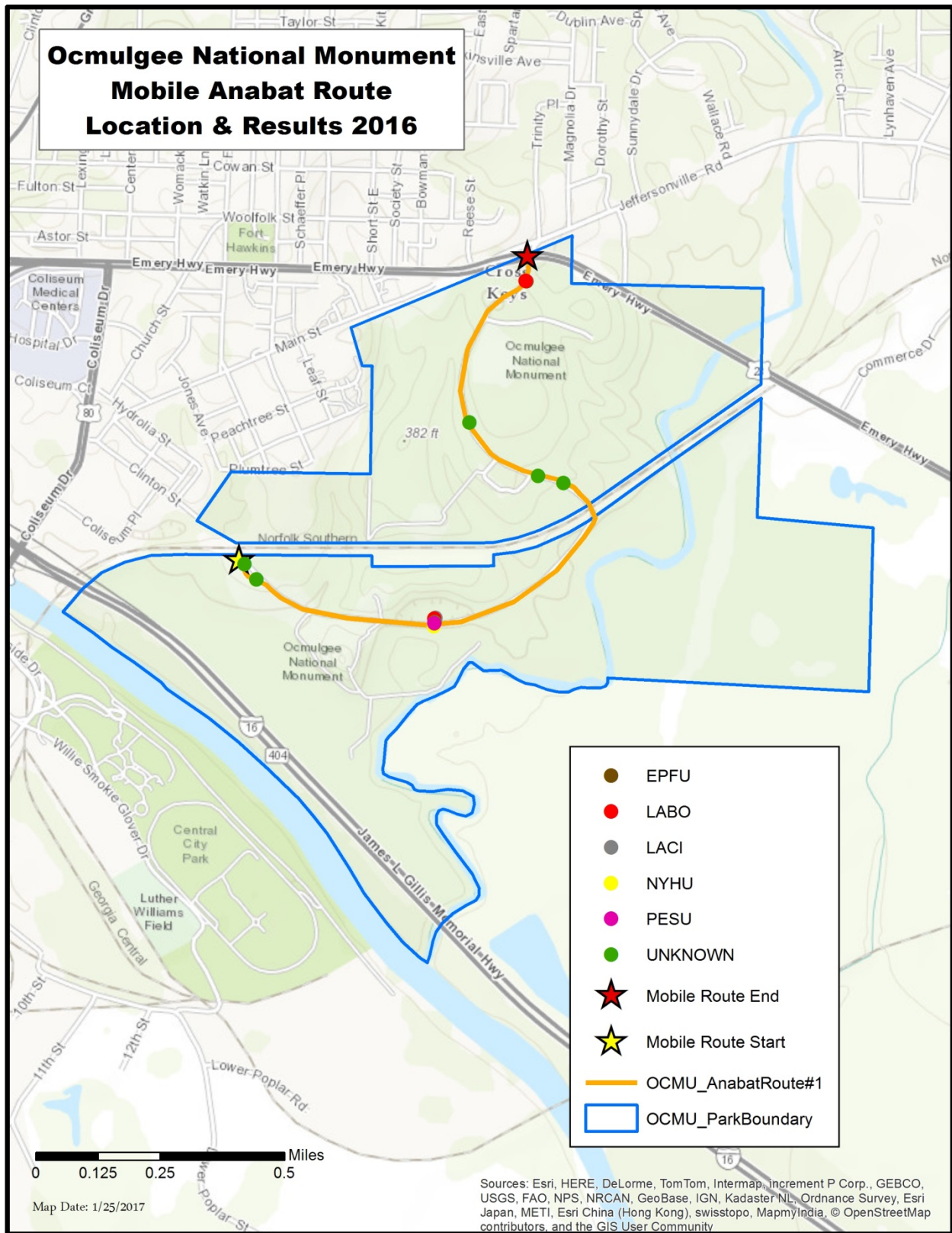


Figure 5. OCMU Mobile Anabat route 2016 locations and results.

Table 3. Nightly activity (passes/transect) by species during mobile route at OCMU in 2016. *EPFU* *Eptesicus fuscus*, *LANO* *Lasionycteris noctivagans*, *LABO* *Lasiurus borealis*, *LACI* *Lasiurus cinereus*, *MYSP* *Myotis species*, *NYHU* *Nycticeius humeralis*, *PESU* *Perimyotis subflavus*, *UNKN* unknown

Site Sampled	Sampling Dates	EPFU	LANO	LABO	LACI	MYSP	NYHU	PESU	UNKN
OMMA2016	5/25/16	2		3	1	0	1	1	11

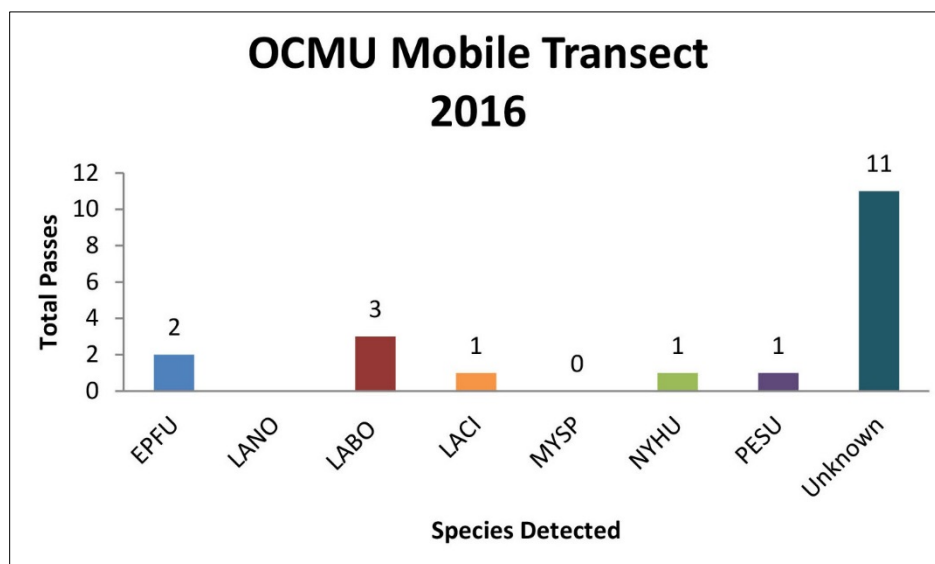


Figure 6. Total acoustic passes recorded during mobile transect at OCMU in 2016 by species.

NABat Stationary AnaBat Units and Mobile Transects

The North American Bat Monitoring Program (NABat) was created as a coordinated response to the current and emerging threats facing North American bats. To contribute to the long-term effective conservation of North American bat species, NABat aims to document and monitor changes in North American bat populations, while assessing management actions employed to mitigate ongoing threats (Loeb et al. 2015). NABat protocol uses 2 approaches to acoustic surveying to monitor changes in bat populations: stationary point surveys and mobile transects.

Site selection is based on priority sampling cells that were randomly selected across North America. Both OCMU and Cumberland Island NPS properties were selected because the sites included the highest ranked cells on NPS properties in Georgia. In accordance with NABat protocol, 3 stationary point surveys were conducted from July 15 to 18, 2016 using AnaBat Express detectors (Titley Scientific, Brendale, Australia). Detectors were housed in a plastic weatherproofing case and mounted above 1.5m on trees with microphones oriented away from vegetation or other obstructions (Britzke et al. 2010). Detectors were deployed at each sampling point to record bat echolocation sequences for a minimum of 4 nights, resulting in 12 total detector nights. Detectors used a built-in GPS feature to program sunset and sunrise

times for automatic night recording. Sampling on nights with moderate to heavy rain was avoided when possible.

NABat mobile transects were conducted over 2 nights in July 2016 with AnabaSD2 bat detectors (Titley Electronics, Ballina, Australia) fixed to the roof of a vehicle, which was then driven slowly (< ~10 km/h) along the predetermined OCMU route. The transect surveys commenced 45 min after sunset.

Bat echolocation call files were identified to species using Echoclass v. 3.1 bat call analysis software (Eric Britzke, ERDC) with the Species Set 1 classifier and a minimum of 3 call pulses. All passes identified as possible *Myotis* spp. were manually examined to verify accuracy of the identification using AnaLookW v. 4.2f software (Titley Scientific, Columbia, MO).

Bat activity was recorded in all 3 NABat stationary survey sites sampled in 2016, although the level of activity (mean number passes/night) varied by site. *Myotis* spp. identified by Echoclass software were classified after manual examination as other species. Six species were identified from the NABat stationary survey sites (Table 4). Eastern red bats and big brown bats were the most commonly recorded species identified.

In addition to one verified *Myotis* spp. pass, 6 other species were identified from the mobile transects (Table 5). Eastern red bats were the most commonly recorded species identified. Based on call characteristics, the *Myotis* pass detected was most likely a Northern long-eared bat.

A summary of the 2016 NABat acoustic stationary sampling and mobile transect locations and their results are below.

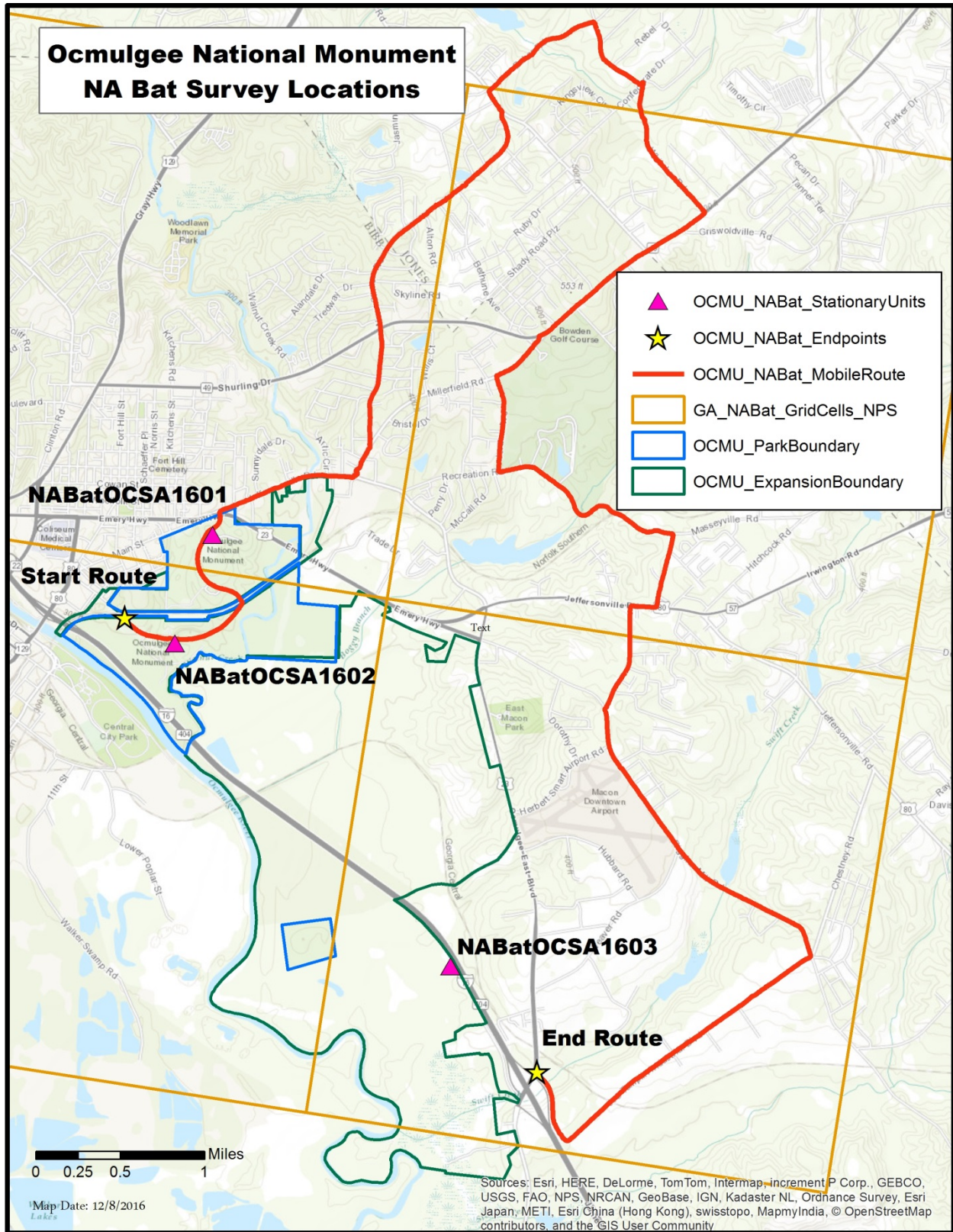


Figure 7. NABat sampling locations at OCMU in 2016.

Table 4. Mean NABat activity (passes/detector night) by species in various sampling sites at OCMU in June-July 2015 and 2016. *EPFU* *Eptesicus fuscus*, *LANO* *Lasionycteris noctivagans*, *LABO* *Lasiurus borealis*, *LACI* *Lasiurus cinereus*, *MYSP* *Myotis species*, *NYHU* *Nycticeius humeralis*, *PESU* *Perimyotis subflavus*, *UNKN* *unknown*

Site Sampled	Sampling Dates	EPFU	LANO	LABO	LACI	MYSP	NYHU	PESU	UNKN
NABatOCSA1601	7/15/16-7/18/16	22	5	108	40	0	2	5	183
NABatOCSA1602	7/15/16-7/18/16	18	1	206	5	0	0	27	1022
NABatOCSA1603	7/15/16-7/18/16	57	2	22	1	0	1	2	89

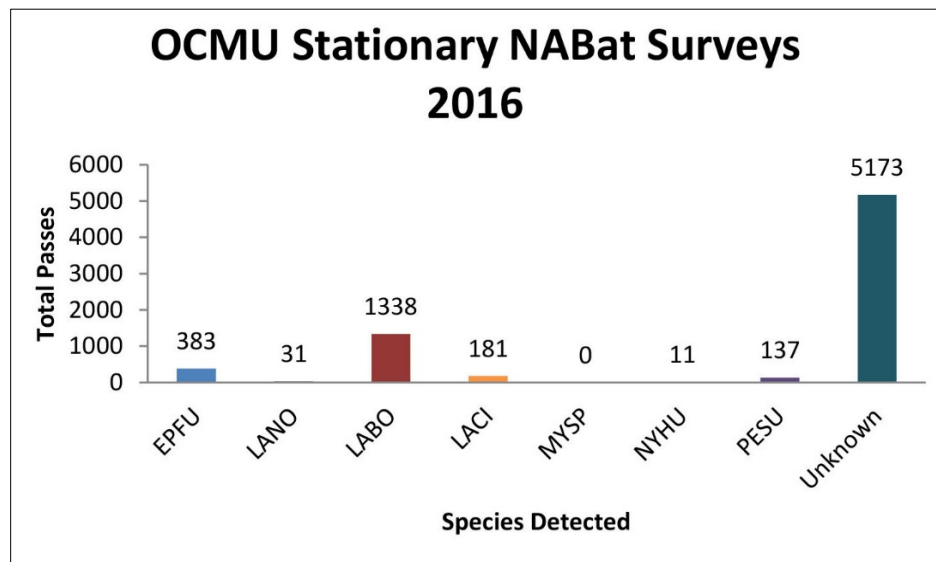


Figure 8. Total NABat stationary acoustic passes recorded at OCMU in June-July 2015 and 2016 by species.

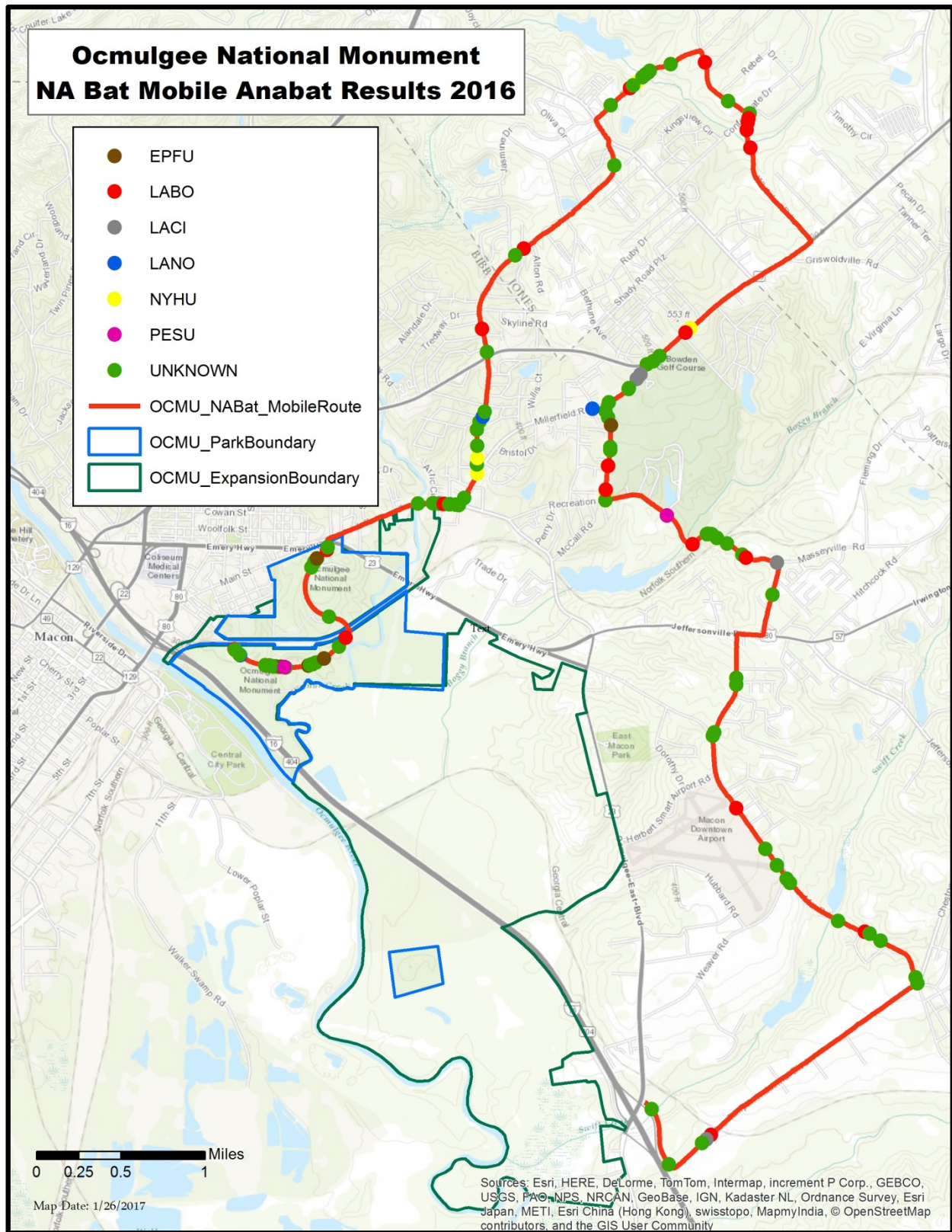


Figure 9. OCMU NABat Mobile Anabat route 2016 locations and results.

Table 5. Nightly activity (passes/transect) by species during NABat mobile transects at OCMU in 2016. *EPFU* *Eptesicus fuscus*, *LANO* *Lasionycteris noctivagans*, *LABO* *Lasiurus borealis*, *LACI* *Lasiurus cinereus*, *MYSP* *Myotis species*, *NYHU* *Nycticeius humeralis*, *PESU* *Perimyotis subflavus*, *UNKN* unknown

Site Sampled	Sampling Dates	EPFU	LANO	LABO	LACI	MYSP	NYHU	PESU	UNKN
NAB_OMMA1601	7/15/16	5	1	13	8	1	5	2	59
NAB_OMMA1602	7/16/16	1	2	15	1	0	1	1	64

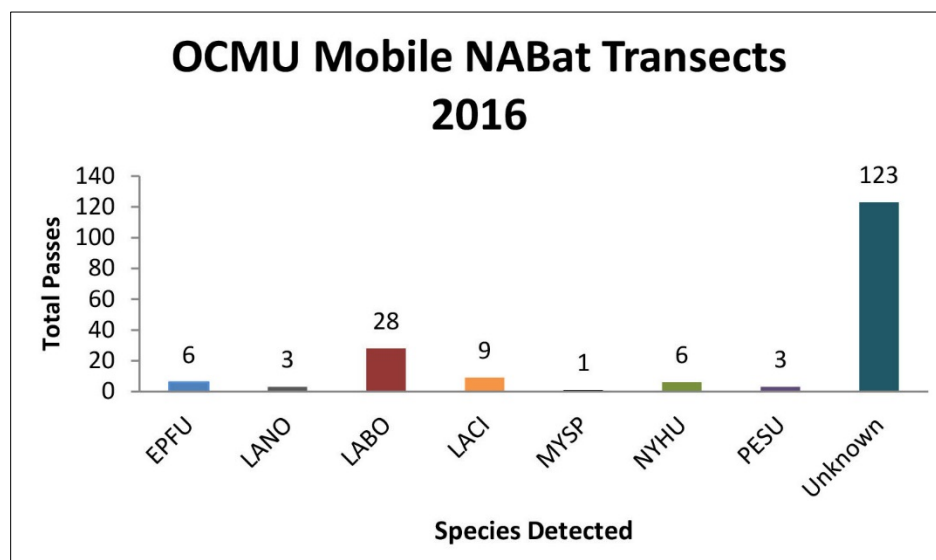


Figure 10. Total acoustic passes recorded during NABat mobile transects at OCMU in 2016 by species.

Recommendations for Future Bat Monitoring

Future bat monitoring should focus on continuing the NABat protocol surveys to determine changes in populations and help inform management strategies. Surveys should be conducted during the summer active period prior to the young becoming volant. Stationary acoustic surveys should be conducted at least once per year with a minimum of 4 nights sampled. If possible, mobile transects should be conducted concurrently with stationary monitoring, with transects surveyed at least twice within a week's time. Surveys should be conducted when weather conditions are optimal for bat activity: (1) seasonally warm temperatures, (2) low wind, and (3) little or no rain.

If additional monitoring is possible, attention should be directed toward stationary Anabat surveys, as mobile transect routes in OCMU are not as productive. Priority of non-NABat stationary surveys should be given to the most productive sites, both in terms of call frequency and species richness, in addition to sites where *Myotis* spp. have been detected such as; OMSA15-1601, CBSA1604, OMSA1603, OMSA15-1605.

Future mist-netting is advised to confirm the presence of recorded *Myotis* spp. The detection of Southeastern myotis is not surprising. This species is found in bottomland hardwood swamps in the southern portion of the state and has been found just south of OCMU at Ocmulgee Wildlife Management area. The detection of Northern long-eared bats is more surprising, however. This species has never been captured in this area and is not expected to range throughout Georgia. However, recent expansions in survey efforts in other SE coastal states have resulted in captures of this species in coastal areas. Because of the difficulty in correctly identifying *Myotis* spp. from their calls, hand captures are needed to verify the presence of these species. With this initial inventory work we did not have enough time or qualified staff to adequately sample the area with mist netting.

Acknowledgements

Completion of this work would not have been possible without the efforts of two DNR employees, Jackie Beck and Rebekah Tuck. Jackie and Rebekah took responsibility for developing a schedule, planning surveys, completion of sampling, maintaining data and supervising the seasonal employees working on the project. Those seasonal University of Georgia employees were also critical in the completion of this project. We greatly appreciate the efforts of Sarah Sherburne, Garrett Roper, Kelly Lutsch, Pallavi Surajuddin, Kyle Shute, Sarah Gorton and Elysia Webb. We would also like to sincerely thank DNR employees Leanne Burns, Cindy Alcazar and Laci Coleman. Their work organizing data from the two field seasons, analyzing thousands of bat calls and writing reports was invaluable. We would also like to thank the Georgia Forestry Commission for assistance with housing and the many National Park Service staff and volunteers who helped us over the two years of this project.

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