ERDC TR-06-4

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Emerging Species of Concern Resulting from Urbanization Encroachment near Military Installations

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July 2006

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Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

ABSTRACT

Using data from a DoD Species of Concern (SOC) report and recent evaluations of urbanization encroachment trends near military installations, a prediction of the effect of that urbanization to 2020 on the SOC was made. This was a first-tier analysis of the likelihood that an animal SOC would be adversely affected by urban encroachment in the next 15 years and might seek refuge on the nearby installation. If so, this SOC would become a potentially important species to the Army by requiring increased management and resources.

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PREFACE

This report was prepared by Daniel P. MacDonald, Physical Scientist (GIS), RS/GIS and Water Resources Branch, Cold Regions Research and Engineering Laboratory (CRREL), U.S. Army Engineer Research and Development Center (ERDC), and Robert C. Lozar, Community Planner (retired), Ecological Processes Branch, Installations Division, Construction Engineering Research Laboratory (CERL), ERDC.

This study was conducted as part of the direct-funded research program, under Work Unit # CNN-T602FF, entitled “Quantify Effects of Fragmentation and Approaches to Mitigate.” The technical monitor was Dr. William Severinghaus, Technical Director, and Military Lands Management Division, CERL.

This report was prepared under the general supervision of Timothy Pangburn, Chief, RS/GIS and Water Resources Branch; Dr. Lance Hansen, Deputy Director; and James L. Wuebben, Acting Director, CRREL.

The Commander and Executive Director of the Engineer Research and Development Center is COL Richard B. Jenkins. The Director is Dr. James R. Houston.

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1 INTRODUCTION

Background

One of the most significant issues for land managers at military installations is that of threatened and endangered species (TES) management. To carry out its TES obligations and responsibilities, the Army must ensure that its actions do not jeopardize the continued existence of listed species or adversely modify their critical habitat. Installations may be required to implement conservation measures to minimize the impact of actions on TESs, especially if take is involved. Installations also actively manage for TESs found on site and are required to develop Endangered Species Management Components for their Integrated Natural Resources Management Plan as the primary means for ensuring Endangered Species Act compliance and balancing mission requirements. In addition, all Federal agencies are required to support the recovery of TESs. The recovery requirements are formally stated in a Recovery Plan that is developed as a result of cooperation and interaction among land managers and scientists and approved by the U.S. Fish and Wildlife Service (USFWS) following public review. Recovery plans must identify specific criteria to be met to achieve removal of species from the endangered species list. These criteria typically include designation of both population goals and specification of habitat to be managed to enhance species survival (including DoD lands).

Natural lands outside installations are becoming more developed with transportation, commercial, and residential uses. This process is called urbanization. When urbanization removes habitat outside installations, lands within an installation may become more important for sustaining populations of displaced wildlife. Urbanization may also result in wildlife relocating to less favorable habitat on the installation. What would happen if urbanization off an installation caused a species that did not exist on the installation to now move onto the installation? If that species was identified by a state, federal, or other agency as being rare or suffering from population decline, called a Species at Risk (SAR), occurrence of that SAR on an installation might result in either increased resource requirement or reduced training capacity.

Currently installation staff have good knowledge of what is occurring on their installation land but a much less detailed understanding of issues beyond their installation boundaries. This is logical, since the primary responsibility of the staff is toward the DoD-administered lands. However, this means that trends that are outside installations and that may be important in the future, particularly slow changes, may be unnoticed.

Land use changes in the immediate vicinity of military installations thus have the potential to result in constraints on mission and resource management operations on these installations, labeled by DoD as "encroachment."* Encroachment can compromise sustained and future training and testing missions at an installation. It would be valuable to DoD to know if urbanization may affect the distribution of a SAR so that it may appear on an installation where it had not previously existed.

NatureServe, a non-profit conservation organization, provides scientific information and tools needed to help guide effective conservation action. NatureServe and its network of Natural Heritage Programs (NHPs) are a leading source for information about rare and endangered species and threatened ecosystems. NatureServe has available an extensive database of species, particularly SARs, for the United States (NatureServe 2005). The information can provide DoD and the USFWS with information about SARs on or near military bases. Such information can assist the military in focusing efforts, efficiently and effectively, towards conservation of species that may soon need listing if their populations continue to decline. Some of the SARs may be endemic to military lands, or they may be dependent on military efforts to remain viable. Most importantly, the conservation of SAR habitats could preclude the need to officially list the species as a TES. Early conservation of SARs preserves management options, minimizes the cost for sustaining the population, and reduces the potential for restrictive land use policies in the future. Thus, early conservation has the potential to reduce the DoD resource load (funds and staff time) that must be dedicated for TESs.

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* Encroachment, generally considered to be any action that inhibits the accomplishment of military live fire training and testing, can come in many shapes and forms, ranging from strict enforcement of environmental laws limiting activities on active training ranges, to conflicts with rapidly expanding communities over training-related dust and noise.

Figure 1. Ikonos imagery (left) and the spatial distribution of the 1992 (blue) and 2003 (yellow) urban growth patterns. Using this rate of growth, we extrapolated the pattern to roughly reflect the situation in 2020, from which we could estimate the land (e.g. possible SAR habitat) that could be affected.

Of particular interest is a NatureServe product resulting from a legacy funded study called *Species at Risk on Department of Defense Installations* (NatureServe 2004). This report included an Excel file evaluation of SARs near installations. We suspected that it would be possible to manipulate this file so that it could be spatially joined to appropriate installations GIS files. Once this was accomplished, we would know which SARs were known to be located near installations. By using a separate spatial data set—the USGS/EPA National Land Cover Data (NLCD)—we would be able to generate for each SAR a very rough five-mile buffer habitat map. This would indicate where each SAR was located near a military installation. This in itself would be interesting to know, but we wished to see if urbanization might have the potential to encourage the SAR to begin utilization of habitat on the installation.

In a separate project, which we will refer to as the *Urbanization Study*, (Lozar et al., in prep.), the Army wished to use the Ikonos satellite images that DoD was acquiring to generate a standard objective means for determining the rate of development near the boundaries of many military installations throughout the U.S. This was done by comparing the urbanization as derived from Ikonos images (taken roughly in 2003) to the NLCD data roughly reflecting the situation in 1992. This decade difference could not only be used to determine the amount of development but could also be used to project the trend into the future. From these results we believed we would be able to "grow" the current spatial urbanization distributions near an installation to the predicted amount of coverage for the year 2020. Overlaying the growth trend data would show how likely it would be that urban encroachment would affect those SAR habitats by 2020 (Fig. 1).

Objective

Our purpose was to use the urbanization data in conjunction with the NatureServe Excel report to generate a first-tier evaluation of the likelihood that any of the SARs living near Army facilities would be adversely affected by urban encroachment in the next 15 years. If so, this SAR would become a potentially important species to the Army, as it may require increased management focus and resources to help prevent listing or to prepare for the listing of the species.

Scope

This is intended to be only a first-tier evaluation. There is no question that more involved ways exist to evaluate urban encroachment. This study deals only with land use changes, with specific emphasis on residential and urbanization trends. We did not attempt to provide an in-depth evaluation of these trends. Further, the work on this project was limited to the availability of the Ikonos imagery, the NLCD data, and the time available to do the analyses.

This report and the results presented are highly consistent internally, largely because of the application of a single standardized approach. A comparison of these findings with those generated by other techniques will be difficult at the least. We chose a method that was as simple as possible.

The sample of installations within the *Urbanization Study*, (Lozar et al., in prep.), completed by upon which this report is based is not necessarily random; we do not know how they were chosen. However, this is the only large sample of military installations in existence to have undergone such a detailed evaluation.

2 METHODS

Approach

This analysis used Arcview 3.2 and ArcMAP 9 spatial analyst software. The data came from Ikonos imagery, the NLCD, NatureServe data, the Urbanization Study, and installation boundaries.

Normalization of data

The first step was to eliminate those installations that, by the nature of their general characterization in the legacy *Species at Risk* report (NatureServe 2004) need not be considered. Our first action was to eliminate from consideration installations that did not have any SARs in the five-mile buffer area next to the installation, according to the landuse type as stated in the *Species at Risk* data. Table 1 shows the installations excluded from the analysis because there is no threat from SARs migrating onto the installation.

Next we revised the NatureServe data file so that it could be spatially joined to the installations files using the “Join” capabilities available with the ArcGIS program. We decided to limit this research to installations that had nearby SAR animals that might migrate onto the installation. We agree that plants can migrate also and suggest a follow-up analysis addressing plants. However, for the purposes of this report, it was felt that animals might be better able to respond to the pace at which urban sprawl occurs. The next step was to pare this list down to only installations for which we had the required data: the NLCD and Ikonos data. Although the NatureServe data showed that Schofield Barracks was very important, no NLCD data were available for Hawaii, so our analysis could not be carried out there. Yuma PG had so little urbanization along its perimeter that we called it zero. Because it was zero, we could not project its growth, so it also is not included in the analysis below. It might also be useful to do a more detailed investigation of Yuma PG. After these combing steps, 37 major installations remained to be investigated.

For each SAR we generated a very rough five-mile buffer habitat map using the USGS/EPA NLCD land use data. General habitat descriptions were developed from on-line NatureServe (http://www.natureserve.org/explorer/) descriptions for the 37 largest installations. (No NLCD data exist for Alaska, Hawaii, and Puerto Rico, so installations in those areas could not be evaluated.)

Table 1. Species of concern residing or occurring on installations.

Installation	Residing on installation	Residing in buffer	Occurring on installation	Occurring in buffer
Aliamanu Military Reservation	1	0	1	0
Anniston Army Depot	2	0	3	0
Camp Bonneville Military Reservation	2	0	3	0
Camp H. M. Smith Marine Corps Base	1	0	1	0
Camp Lejeune Marine Corps Base	8	0	13	0
Camp Roberts Military Reservation	1	0	4	0
Cecil Field Naval Air Station (Closed)	2	0	2	0
Dare County Range	1	0	1	0
Dugway Proving Grounds	2	0	3	0
Eklutna Army Mountain and Glacier	1	0	1	0
Fern Ridge Lake	1	0	1	0
Fort Belvoir Military Reservation	1	0	1	0
Fort Eustis Military Reservation	1	0	2	0
Fort Gordon	4	0	8	0
Fort Greely (Scheduled to close)	1	0	1	0
Fort Hood	1	0	2	0
Fort Jackson	5	0	6	0
Fort McClellan Military Reservation	5	0	7	0
Fort Pickett Military Reservation	2	0	2	0
Fort Wainwright	1	0	1	0
Fort Wingate Depot Activity (Closed)	1	0	2	0
Holley Field	1	0	1	0
Hunter Army Airfield	1	0	1	0
Jacksonville Naval Air Station	2	0	2	0
Jefferson Proving Ground (Closed)	2	0	2	0
Lake Cumberland	1	0	1	0
Lakehurst Naval Air Station	3	0	4	0
March Air Force Base (Closed)	1	0	1	0
Moffett Field Naval Air Station	1	0	1	0
Mohawk Reservoir	2	0	2	0
Moody Air Force Base	1	0	2	0
Mount Morris Lake	1	0	1	0
Nevada Test Site	1	0	5	0
Oakland Army Base (Closed)	1	0	1	0
Radford Army Ammunition Plant	1	0	1	0
Robins Air Force Base	2	0	3	0
Saddlebunch Keys Naval	3	0	3	0
Saufley Field	1	0	1	0
Saylor Creek Air Force Range	1	0	2	0
Tustin Marine Corps Air Station	1	0	2	0
United States Air Force Academy	1	0	2	0
Wendover Range	1	0	1	0
West Point Lake	1	0	1	0
Whitehouse Field	1	0	1	0

* Occurring meant traveling through, residing is living on the installation

At the same time, from the Urbanization Study results, we “grew” the current spatial urbanization distributions as determined for (roughly) the situation in the year 2003 near an installation (Fig. 2). To grow the distribution in Figure 2, we applied a simple “eight-corner neighborhood” analysis. (An eight-corner analysis consists of taking the average of the eight surrounding cells and applying that value to the center cell.) This was repeated until the amount of land covered by the red urban area was equal to the percent predicted (using a straight-line trend) for the year 2020 (Fig. 3). In areas of low growth, a “four-corner neighborhood” analysis or a “two-corner neighborhood” analysis would be used to gain a result that as closely as possible reflected the coverage predicted in the Urbanization Study.

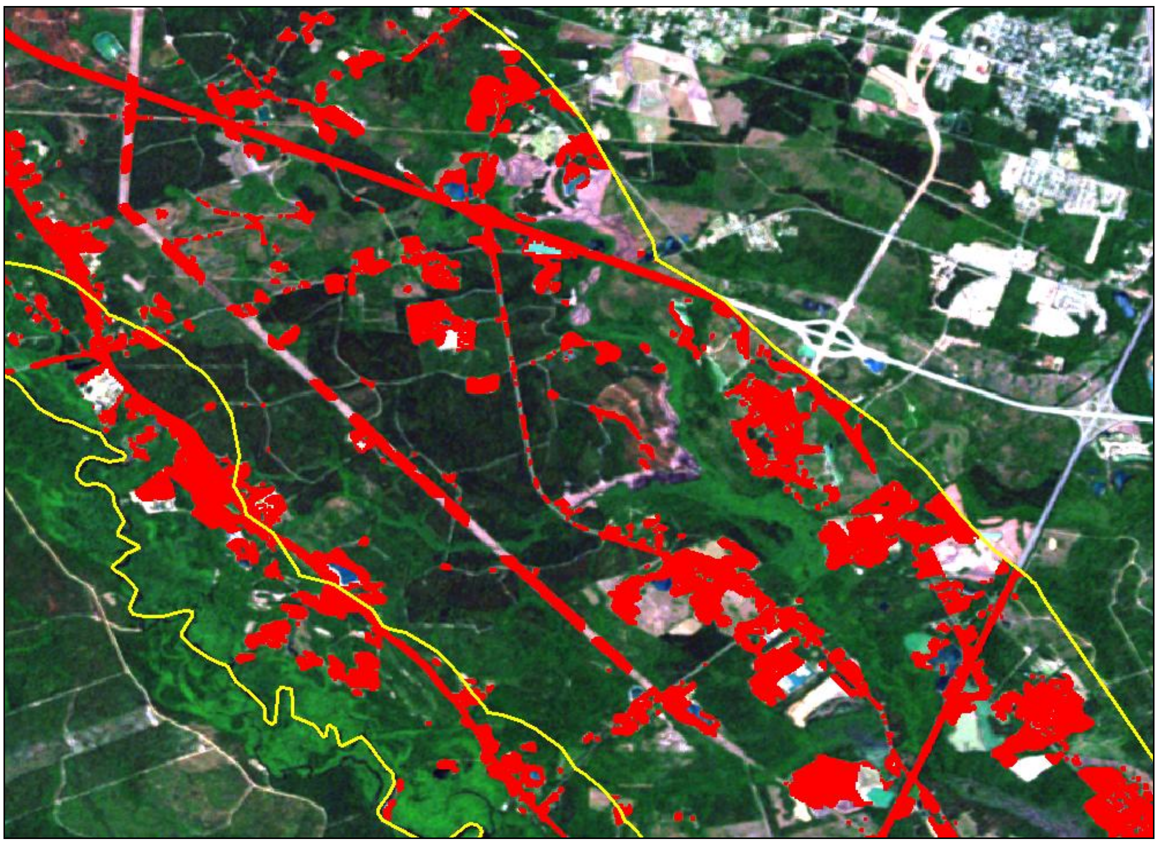

Figure 2. Sample urbanization distribution in 2003 (red) as determined in the Urbanization Study. The yellow installation boundary is in the lower left; the other yellow lines show the one-mile and five-mile buffers.

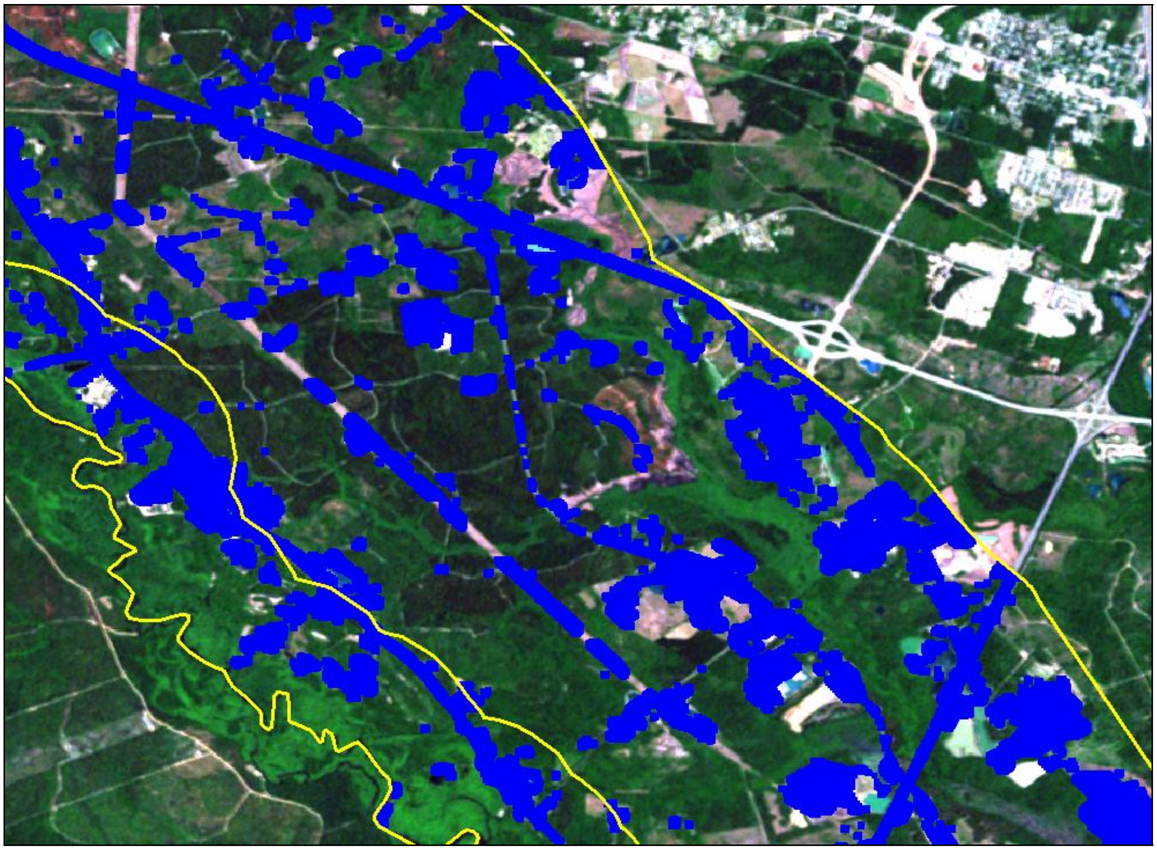

Figure 3. Urban areas (blue) grown until the coverage was equal to that predicted for the year 2020 in the Urbanization Study.

The Urbanization Study results for 2003 and the predicted urban encroachment for 2020 were reclassed, with non-urban equaling zero and urban equaling ten. The NLCD data were also reclassed, with no SAR habitat equaling zero and SAR habitat equaling one (Fig. 4).

Appendix A gives the numerical value of the generated rough habitat for each species at each installation.

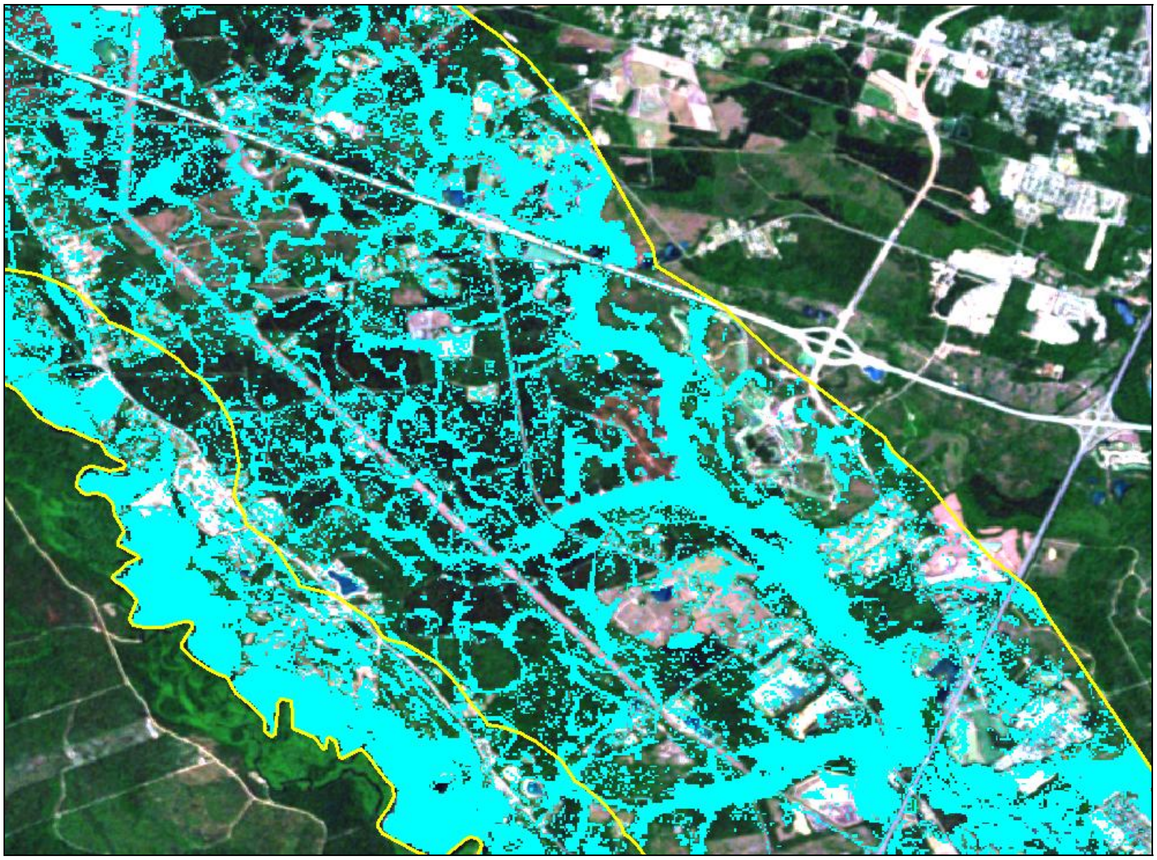

Figure 4. Approximate areas of potential SAR habitats (light blue).

The two maps (habitat and 2020 urban areas) were added to generate a new map. A value of 11 (light green) indicated locations where habitat and urban areas overlapped in 2003 (Fig. 5) and where urban areas are projected to be formed by 2020 (Figure 6). Areas with values equaling one (red) are the projected SAR habitat extents in 2020. For both the 2003 and 2020 maps, the urban data had a higher degree of detail or "resolution" so the urban area that coincided with the NLCD data value 11 in both maps had to be taken out of the habitat count. The percent of habitat loss was calculated by subtracting the habitat area for 2003 (Fig. 5) from that in 2020 (Fig. 6) and then dividing that by the amount of habitat area in 2003. The current habitat area boundaries are in yellow; the red areas on top of the yellow show how much habitat may be lost by the year 2020 (Fig. 7).

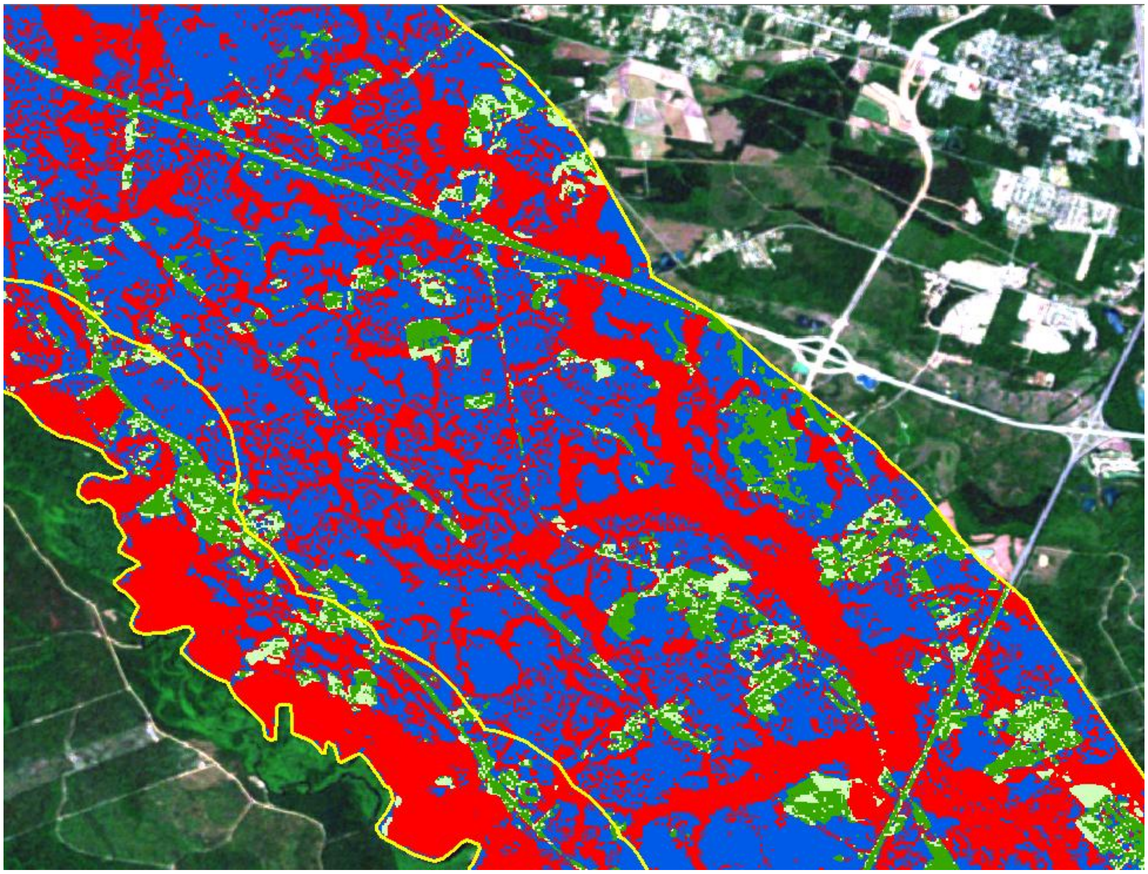

Figure 5. SAR habitat (red) for 2003.

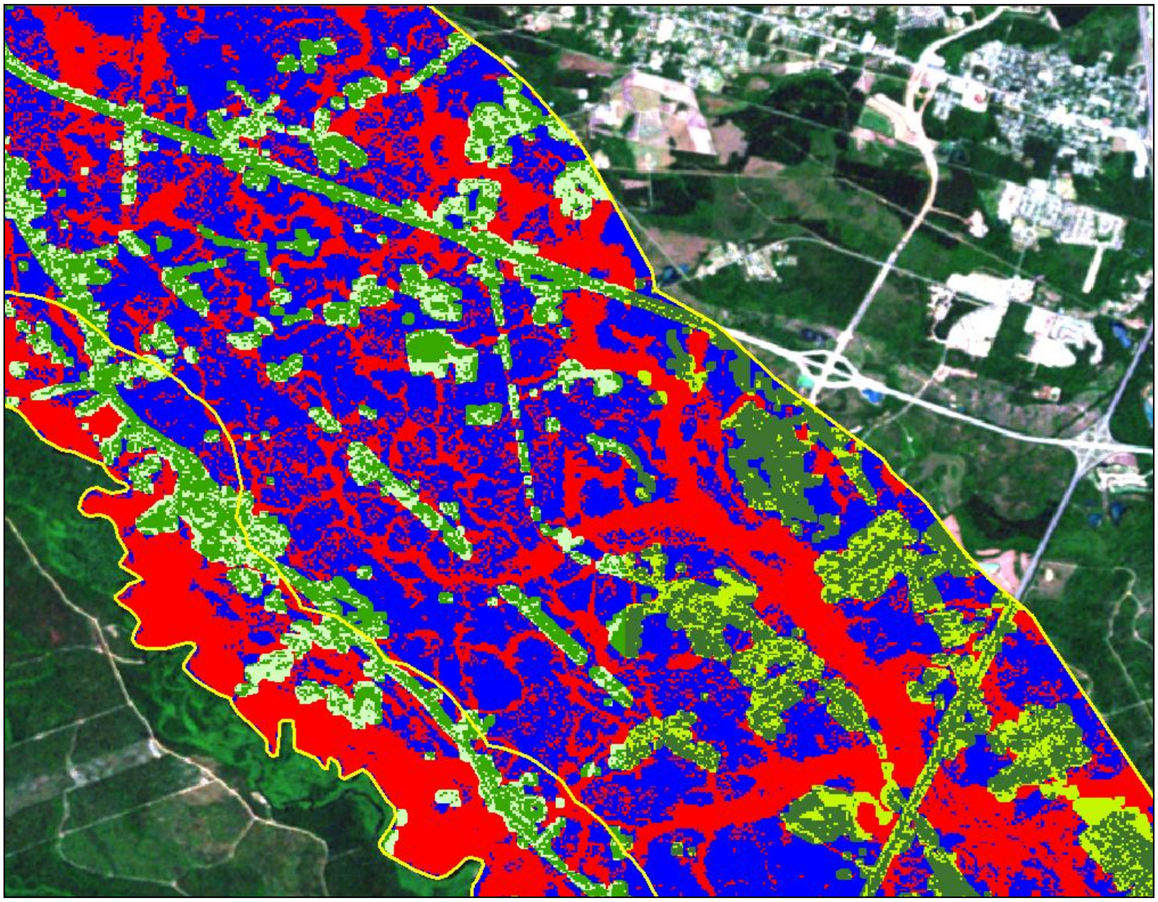

Figure 6. Urban encroachment onto SAR habitat (light green) as estimated for 2020 versus potential SAR habitats (red).

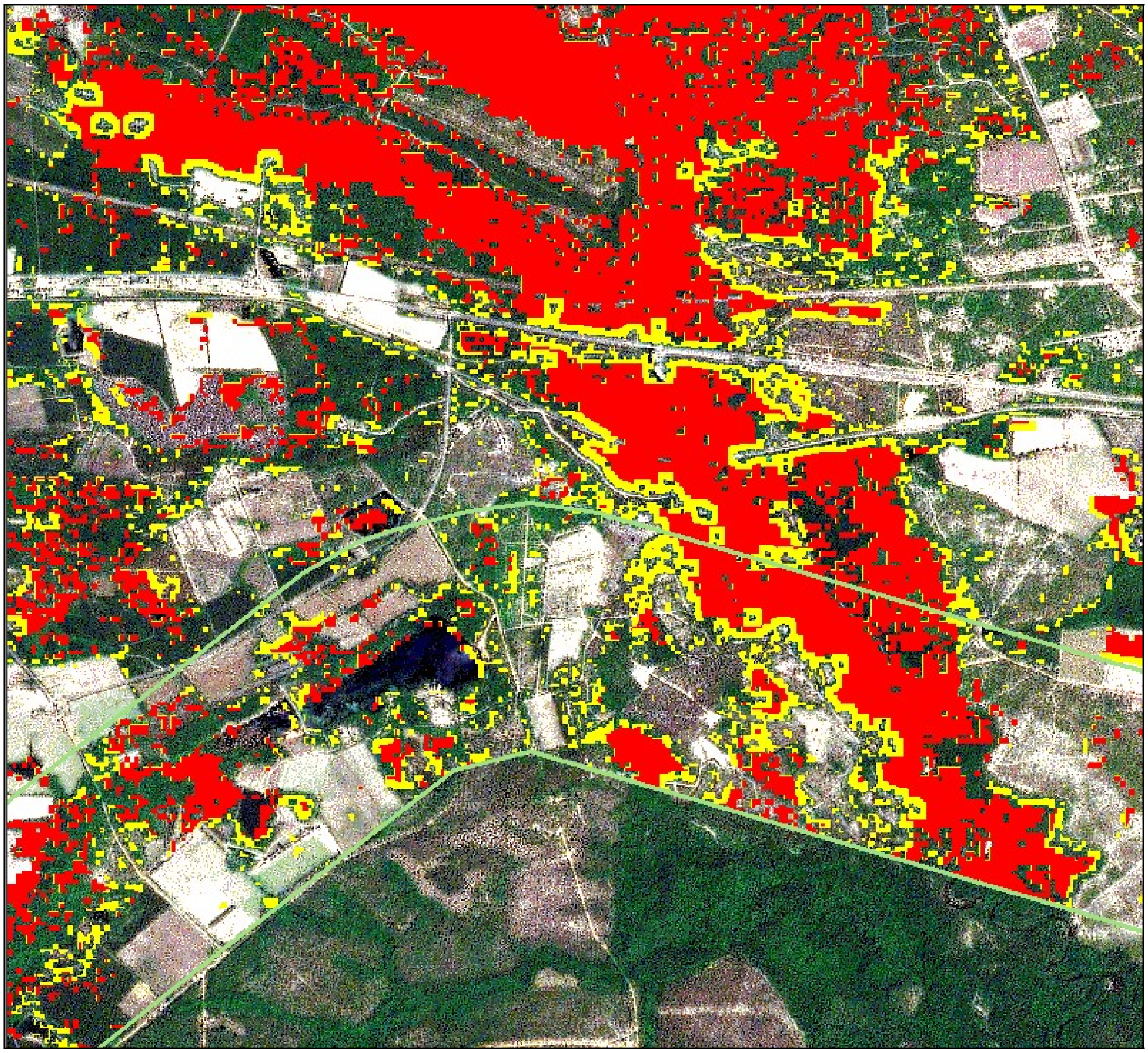

Figure 7. Habitat loss. The yellow boundaries are the extent of the present habitat area. The red area overlying the yellow is the 2020 habitat extent. Yellow areas are the habitat loss by 2020.

Results of Species at Risk Evaluations

Table 2 presents the results of urbanization and SAR evaluation. Items of interest from this table are:

- There was a high number of SARs at some of the installations. For example, Schofield Barracks had the highest number of SAR animal species (five).

- Many installations had one or two species.
- Many of the western U.S. installations exhibit less urban encroachment than those in the eastern U.S. Some (usually eastern) installations are already nearly completely urbanized. With little remaining habitat to be lost, the possibility to act as a nurturing location for displaced species may be more significant than the statistics suggest.
- High urban growth does not necessarily mean high habitat loss. For example, Fallon Air Force Base has a high urbanization rate but low habitat loss.
- However, in most cases high urbanization is a good metric for potential encroachment by SARs because the process of urbanization usually removes species habitat.

Table 2. Results of urbanization and SAR evaluation.

Installation	Total number of SARs	Percent highest SAR habitat loss
Schofield Barracks	15	NA
Fort Lewis	1	60.88
Camp Pendleton	3	54.45
Fort Knox	2	32.32
Eglin Air Force Base	5	27.99
Fort McCoy	2	19.92
Fort Bragg	1	11.29
Camp Lejeune	1	6.63
Rock Island Arsenal	1	5.75
Fort Dix	5	3.93
Fort Stewart	2	3.53
Redstone Arsenal	1	2.84
Sierra Army Depot	1	2.64
Fallon Air Force Base	2	2.62
Fort Polk	1	1.56
West Point Military Academy	1	0.92
Fort Leonard Wood	2	0.55
Fort Huachuca	2	0.54
Deseret Chemical Plant	1	0
Fort Irwin	1	0

3 DISCUSSION

Table 2 shows installations in order of SAR habitat loss caused by expected urban growth to roughly 2020. It indicates installations that are at high risk for animal SAR migration onto the base, which could result in increased management and resources commitments by the installation. The percent habitat loss corrects for situations where there exist several species with overlapping habitats (i.e. overlapping habitats are not double counted).

Table 1shows the installations that need not worry about animal SAR onto the installation. Schofield Barracks is at the top of this list for a reason. It had far more SARs than any other installation we investigated. It also is situated in an area that is clearly quickly urbanizing. Unfortunately, because it is in Hawaii, there are no NLCL data to provide a basis for the 1992 situation. In spite of the lack of a formal analysis, it is clear that this installation belongs at the top of this list. It is recommended that another analysis be done just for Schofield Barracks to objectively set values to this obvious situation.

Some issues have arisen during the research that need to be documented.

- Does there exist on the installation habitat adequate to support a migrating animal? Since this study focused only on the five-mile buffer, this issue was not investigated. It is an obvious next step, and this question would be easy to answer with the existing data.
- The migration rates or the ability of a species to move need to be incorporated into the next-tier analysis to indicate the distance and speed that a species could be expected to migrate.
- What is the interrelationship between the SARs on installations that have multiple SARs in or around the installation? The sizes of the habitat fragments were not taken into consideration. Some species need a minimum area to exist.
- Symbiotic relationships between animals and plant SAR were not investigated. If an animal SAR depends on a plant SAR and the plant SAR cannot migrate with its animal SAR, then the migration of a plant-dependent animal SAR is a moot point; it will not occur.

4 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The SAR data and the urbanization encroachment trends near military installations have provided a first-tier analysis of the likelihood of any of the SARs being adversely affected by urban encroachment in the next 15 years. The study has shown that many of the installations are not likely to be affected by SARs. The installations that are affected have been ranked in a “risk” table. The table can then be used to evaluate the SARs near the installations and thereby deduce which installations are liable to have increased management and resources requirements.

Table 1 represents an important conclusion, although it was only a step in this process. It is the list of installations not at risk of encroachment by new species of concern for both plants and animals. This is useful in itself.

Table 2 shows those installations that are at risk of “encroachment” by new SARs in the buffer area. The individual SARs for each installation is listed in Appendix 1. We have placed Schofield Barracks at the top of the list because it has more SARs than any other installation and is in an area with a high rate of urbanization. Because NLCD does not cover Hawaii, we could not carry out a complete analysis. However, logic demands that it stand in the first rank. Those installations that show SAR potential habitat of greater than 25% are (in order of greatest habitat loss first) Fort Lewis, Washington; Camp Pendleton, California; Fort Knox, Kentucky; and Eglin Air Force Base, Florida. These four are certainly at risk, and actions need to be taken at once to ensure that the risk is minimized. Of high concern are also Fort McCoy, Wisconsin; Fort Bragg, South Carolina; Camp Lejeune, North Carolina; and Rock Island Arsenal, Illinois. Although they are in the next tier of installations, both Fort Dix, New Jersey, and Fort Stewart, Georgia, have multiple SARs of concern. So little habitat will be urbanized in the next 1520 years that no additional risk is likely at Fort Polk, Louisiana; West Point Military Academy, New York; Fort Leonard Wood, Missouri; Fort Huachuca, Arizona; Deseret Chemical Plant, Nevada; and Fort Irwin, California.

Recommendations

We decided to limit this research to installations that had nearby SAR animals that might migrate onto the installation. We agree that plants can migrate also and suggest that that be a follow-up analysis.

Schofield Barracks was a very important installation for SARs in the NatureServe data, but no NLCD data were available for Hawaii, so our analysis could not be carried out there. This single installation had far more SARs than any other location, so it is recommended that a separate analysis be carried out for it.

Yuma PG had so little urbanization along its perimeter that we called it zero. Because it was zero, we could not project its growth, so it also is not included in the analyses. It might also be useful to do a more detailed investigation of Yuma PG, but it is not one where an SAR migration problem is likely to emerge.

This study focused only on the five-mile buffer, but for migration to occur, we need to know if there exists on the installation habitat adequate to support a migrating animal. This question would be easy to answer with the data already at hand and would further refine the results here.

Determining the migration rates or the ability of a species to move could further refine this analysis. An analysis to indicate the distance and speed that a species could be expected to migrate would be useful.

The use of data more specific to the habitat requirement of the specific SAR would undoubtedly result in a more accurate study.

It would be useful to apply the software tool among the IMAGINE Remote Sensing capabilities called the Expert Classifier. This has the possibility to generate multiple spatial indexes to refine the conclusions here. The results also can be used to better rank the installations.

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APPENDIX A: CHARACTERIZATION FOR EACH INSTALLATION

All habitat information came from www.natureserve.org.

FORT LEWIS

Taylor's Checkerspot, Whulge Checkerspot Butterflies (*Euphydryas editha taylori*)

Habitat

Grasslands, prairies, and oak woodlands

NLCD Classes

41 Deciduous Forest
71 Grasslands/Herbaceous
81 Pasture/Hay

Habitat Loss

1,478,419 in 2003
578,329 in 2020
60.88% loss of habitat

CAMP PENDLETON

Southwestern Pond Turtle (*Clemmys marmorata pallida*)

Habitat

Water and sand hills

NLCD Classes

11 Water
33 Transitional
51 Shrubland
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

958,586 in 2003
828,322 in 2020
13.58% loss of habitat

San Diego Ringneck Snake (*Diadophis punctatus similis*)

Habitat

Moist situations in varied habitat ranging from chaparral covered hillsides, canyons, grassland, and oak woodland

NLCD Classes

41 Deciduous Forest
43 Mixed Forest
51 Shrubland
61 Orchards/Vineyard
71 Grasslands/Herbaceous
81 Pasture/Hay
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

1,269,221 in 2003
1,035,301 in 2020
18.43% loss of habitat

Arroyo Chub fish (*Gila orcutti*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

5,226 in 2003
2,380 in 2020
54.45% loss of habitat

FORT KNOX

Louisville Crayfish (*Orconectes jeffersoni*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

378,433 in 2003
266,813 in 2020
29.49% loss of habitat

A Cave Obligate Millipede (*Pseudotremia conservata*)

Habitat

Caves

NLCD Classes

31 Bare Rock
32 Quarries/ Mines
33 Transitional

Habitat Loss

34,935 in 2003
23,641 in 2020
32.32% loss of habitat

EGLIN AIR FORCE BASE

Escambia Map Turtle (*Graptemys ernsti*)

Habitat

Water and sand hills

NLCD Classes

11 Water
33 Transitional
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

163,209 in 2003
126,425 in 2020
22.53% loss of habitat

Southern Hognose Snake (*Heterodon simus*)

Habitat

Open, xeric habitats with well-drained, sandy soils such as sand ridges, pine flatwoods, mixed oak-pine forests, and oak hammocks are utilized; also fields and river floodplains.

NLCD Classes

33 Transitional
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
61 Orchards/ Vineyard
71 Grasslands/Herbaceous
81 Pasture/Hay
82 Row Crops
83 Small Grains
84 Fallow
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

1,208,756 in 2003
1,001,280 in 2020
17.16% loss of habitat

Florida Bog Frog (*Rana okaloosae*)

Habitat

Early successional shrub bog communities; in or near shallow, nonstagnant, and along shallow, boggy overflows of larger seepage streams that drain extensive sandy uplands, frequently in association with lush beds of sphagnum moss.

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

124,275 in 2003
89,482 in 2020
27.99% loss of habitat

Sherman's Fox Squirrel (*Sciurus niger shermani*)

Habitat

Longleaf pine sandhills and flatwoods; best habitat contains both pines and oaks, such as along the edge of longleaf pine savanna and live oak forest.

NLCD Classes

33 Transitional
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
91 Woody Wetlands

Habitat Loss

1,165,150 in 2003
973,119 in 2020
16.48% loss of habitat

Florida black bear (*Ursus americanus floridanus*)

Habitat

Large undeveloped wooded tracts; pine flatwoods, hardwood swamp, cypress swamp, cabbage palm forest, sand pine scrub, and mixed hardwood hammock

NLCD Cclasses

41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

1,126,559 in 2003
936,359 in 2020
16.88% loss of habitat

FORT MCCOY

Red Veined Prairie Leafhopper (*Aflexia rubranura*)

Habitat

Inhabitants of dry to wet-mesic prairies

NLCD Classes

51 Shrubland	82 Row Crops
71 Grasslands/Herbaceous	83 Small Grains
81 Pasture/Hay	84 Fallow

Habitat Loss

2,041,729 in 2003
1,634,921 in 2020
19.92% loss of habitat

Tiger Beetle (*Cicindela patruela huberi*)

Habitat

Semi-open pine barrens or dry oak woodlands where open ground exists, such as along trails.

NLCD Classes

41 Deciduous Forest	43 Mixed Forest
42 Evergreen Forest	

Habitat Loss

3,796,742 in 2003
3,418,054 in 2020
9.97% loss of habitat

FORT BRAGG

Star-nosed Mole - Eastern North Carolina (*Condylura cristata* pop. 1)

Habitat

This mole prefers moist, sandy, and loamy soils in fields, meadows, pastures, and open woodlands.

NLCD Classes

41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
61 Orchards/ Vineyard
71 Grasslands/Herbaceous
81 Pasture/Hay
82 Row Crops
83 Small Grains
84 Fallow

Habitat Loss

7,495,667 in 2003
6,649,091 in 2020
11.29% loss of habitat

CAMP LEJEUNE

Southern Hognose Snake (*Heterodon simus*)

Habitat

Open, xeric habitats with well-drained, sandy soils such as sand ridges, pine flatwoods, mixed oak-pine forests, and oak hammocks are utilized; also fields and river floodplains. Vegetative associations of dry upland species vary within the range.

NLCD Classes

31 Bare Rock
32 Quarries/ Mines
33 Transitional
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
71 Grasslands/Herbaceous
81 Pasture/Hay
82 Row Crops
83 Small Grains
84 Fallow
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

2,697,378 in 2003
2,518,433 in 2020
6.63% loss of habitat

ROCK ISLAND ARSENAL

Freshwater Mussels (*Cumberlandia monodonta*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

81,659 in 2003
76,956 in 2020
5.75% loss of habitat

FORT DIX

Buchholz's Dart Moth (*Agrotis buchholzi*)

Habitat

While food plant usually occurs on sites that are dry at the surface, such microhabitats are often on pitch pine lowlands, which are often considered wetlands. Wetland shrubs such as leatherleaf commonly occur very near the food plant, but so can blackjack oak, an extreme xerophyte.

NLCD Classes

42 Evergreen Forest
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

2,148,558 in 2003
2,105,702 in 2020
1.99% loss of habitat

Precious Underwing (*Catocala pretiosa pretiosa*)

Habitat

Typical habitat would be a pinelands swamp forest. Strays to and will breed in other forested habitats.

NLCD Classes

41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

4,301,085 in 2003
4,131,651 in 2020
3.93% loss of habitat

Daecke’s Pyralid Moth (*Crambus daeckellus*)

Habitat

Very closely associated with Xerophyllum in recently burned pitch pine lowlands at all modern sites.

NLCD Class

42 Evergreen Forest

Habitat Loss

1,026,018 in 2003
1,004,767 in 2020
2.0% loss of habitat

Butterfly (*Richia* sp. 2)

Habitat

Habitat at Ft. Dix is *Calamovilfa brevipilis*-pitch pine savannas. This dominant grass is the exclusive larval food plant.

NLCD Class

42 Evergreen Forest

Habitat Loss

1,026,018 in 2003
1,004,767 in 2020
2.0% loss of habitat

A Noctuid Moth (*Spartiniphaga carterae*)

Habitat

Associated with pine barren reed grass (*Calamavilfa brevipilis*), which is probably the exclusive larval foodplant. Normal habitats include edges of boggy shrublands, swales and pitch pine lowlands in New Jersey.

NLCD Classes

42 Evergreen Forest
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

2,148,558 in 2003
2,105,702 in 2020
1.99% loss of habitat

FORT STEWART

Southern hognose snake (*Heterodon simus*)

Habitat

Open, xeric habitats with well-drained, sandy soils such as sand ridges, pine flatwoods, mixed oak-pine forests, and oak hammocks are utilized; also fields and river floodplains. Vegetative associations of dry upland species vary within the range.

NLCD Classes

32 Quarries/ Mines
33 Transitional
42 Evergreen Forest
43 Mixed Forest
51 Shrubland
71 Grasslands/Herbaceous
81 Pasture/Hay
82 Row Crops
83 Small Grains
84 Fallow
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

3,825,190* in 2003
3,689,960 in 2020
3.53% loss of habitat

Striped newt (*Notophthalmus perstriatus*)

Habitat

Sandhill, scrub, scrubby flatwoods, mesic flatwoods, and isolated, ephemeral wetlands within these habitats (e.g., sinkhole ponds, depression ponds and marshes, and ditches). Larvae and adults are aquatic, efts inhabit wooded areas near breeding ponds. Adults immigrate emigrate to surrounding terrestrial habitat if pond dries up. Breeds in temporary ponds. Eggs probably are attached to submerged vegetation.

NLCD Classes

11 Water
32 Quarries/ Mines
51 Shrubland
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

2,915,171 in 2003
2,845,081 in 2020
2.40% loss of habitat

* This is the number of habitat cells for each year. The cells are 4 m^2 each.

REDSTONE ARSENAL

Tuscumbia Darter (*Etheostoma tuscumbia*)

Habitat

Vegetated spring pools and slow streams

NLCD Classes

11 Water
92 Emergent/Herbaceous Wetlands
91 Woody Wetlands

Habitat Loss

656,118 in 2003
637482 in 2020
2.84% loss of habitat

SIERRA ARMY DEPOT

Honey Lake Blue Insects (*Euphilotes pallescens calneva*)

Habitat

Shrubland

NLCD Classes

33 Transitional
51 Shrubland

Habitat Loss

8,106,420 in 2003
7,892,118 in 2020
2.64% loss of habitat

FALLON AIR FORCE BASE

Hardy's Aegialian Scarab Beetle (*Aegialia hardyi*)

Habitat

Kearney buckwheat shrub habitat

NLCD Classes

33 Transitional
51 Shrubland

Habitat

1,151,559 in 2003
1,121,374 in 2020
2.62% loss of habitat

Dune Honey Ant (*Myrmecocystus arenarius*)

Habitat

Kearney buckwheat shrub habitat

NLCD Classes

33 Transitional	51 Shrubland

Habitat Loss

1,151,559 in 2003
1,121,374 in 2020
2.62% loss of habitat.

FORT POLK

A Crayfish (*Orconectes maletae*)

Habitat

Water

NLCD Classes

11 Water	92 Emergent/Herbaceous Wetlands
91 Woody Wetlands	

Habitat Loss

815,686 in 2003
802,916 in 2020
1.56% loss of habitat

WEST POINT MILITARY ACADEMY

Bluestripe Shiner (*Cyprinella callitaenia*)

Habitat

Water

NLCD Classes

11 Water	92 Emergent/Herbaceous Wetlands
91 Woody Wetlands	

Habitat Loss

527,492 in 2003
522,629 in 2020
0.92% loss of habitat

FORT LEONARD WOOD

Freshwater Mussel (*Cumberlandia monodonta*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

134,502 in 2003
133,763 in 2020
0.55% loss of habitat

Bluestripe Darter (*Percina cymatotaenia*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

134,502 in 2003
133,763 in 2020
0.55% loss of habitat

FORT HUACHUCA

Huachuca Springsnail Freshwater Snail (*Pyrgulopsis thompsoni*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

20,802 in 2003
20,690 in 2020
0.54% loss of habitat

Ramsey Canyon Leopard Frog (*Rana subaquavocalis*)

Habitat

Water

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

20,802 in 2003
20,690 in 2020
0.54% loss of habitat

DESERET CHEMICAL PLANT

Least chub (*Lotichthys phlegethontis*)

Habitat

Originally in slow rivers, clear creeks, springs, ponds, and marshes. Now an alkaline spring inhabitant. Typically in moderate-dense submergent and emergent vegetation. Found at depths of 10–90 cm, over bottom of clay, muck, mud, and peat.

NLCD Classes

11 Water
91 Woody Wetlands
92 Emergent/Herbaceous Wetlands

Habitat Loss

13,643 in 2003
13,643 in 2020
0% loss of habitat

FORT IRWIN

Has no urban encroachment anticipated.

Mohave Ground Squirrel (*Spermophilus mohavensis*)

Habitat

Areas with deep sandy or gravelly friable soils and an abundance of annual herbaceous vegetation; alluvial fans where desert pavement is absent

NLCD Classes

33 Transitional
51 Shrubland
71 Grasslands/Herbaceous
81 Pasture/Hay
82 Row Crops
83 Small Grains
85 Urban/Recreational Grasses

Habitat Loss

Zero percent loss of habitat

Schofield Barracks

Urban encroachment could not be determined.

There were no landuse data available.

Amastrid Land Snail (*Amastra micans*)

Amastrid Land Snail (*Amastra rubens*)

Amastrid Land Snail (*Amastra spirizona*)

Pueo bird (*Asio flammeus sandwichensis*)

Achatinellid Land Snail (*Auriculella* aff. *Castanea n*. sp.)

Achatinellid Land Snail (*Auriculella ambusta*)

Achatinellid Land Snail (*Auriculella malleata*)

Achatinellid Land Snail (*Auriculella tenella*)

Amastrid Land Snail (*Laminella sanguinea*)

Amastrid Land Snail (*Leptachatina* sp. 8)

Pupillid Land Snail (*Lyropupa* sp. 1)

Crimson Hawaiian Damselfly (*Megalagrion leptodemas*)

Blackline Megalagrion Damselfly (*Megalagrion nigrohamatum nigrolineatum*)

Helicinid Land Snail (*Pleuropoma sandwichiensis*)

I" Iwi bird (*Vestiaria coccinea*) (Oahu only)

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*
July 2006

2. REPORT TYPE
Technical Report

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE

Emerging Species of Concern Resulting from Urbanization Encroachment near Military Installations

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER
CNN-T602FF

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Engineer Research and Development Center
Cold Regions Research and Engineering Laboratory
72 Lyme Road
Hanover, NH. 03755-1290

8. PERFORMING ORGANIZATION REPORT NUMBER

ERDC TR-06-4

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
Washington, DC 20314-100

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Using data from a DoD Species of Concern (SOC) report and recent evaluations of urbanization encroachment trends near military installations, a prediction of the effect of that urbanization to 2020 on the SOC was made. This was a first-tier analysis of the likelihood that an animal SOC would be adversely affected by urban encroachment in the next 15 years and might seek refuge on the nearby installation If so, this SOC would become a potentially important species to the Army by requiring increased management and resources.

15. SUBJECT TERMS
Encroachment
Military installations
Species of concern
Urbanization

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
U	U	U	U	37	