2003 FINAL REPORT

THE MULTI-SPECIES/HABITAT ECOLOGICAL EVALUATION OF ALTERNATIVE EVERGLADES RESTORATION PLANS.

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Introduction

In May 1999, the U.S. Fish and Wildlife Service completed the South Florida Multi- Species Recovery Plan (MSRP). The MSRP has been prepared to help fulfill the first two of the objectives of the South Florida Ecosystem Restoration Initiative, 1) Restore and protect the biodiversity of native plants and animals in the upland, wetland, estuarine, and marine communities of the South Florida Ecosystem; 2) Recover threatened and endangered species in the South Florida Ecosystem (USFWS, 1999). The MSRP outlines recovery objectives for the 68 threatened and endangered (T&E) species and their habitats in South Florida and was specifically designed to recover multiple species through the restoration of ecological communities within the 19 southern most counties in Florida (Figure 1).

The MSRP document provides a compilation of information on each of the species and communities in a format that can be applied in biological opinions and environmental impact statements, and provides an information base that can be used to identify areas to be acquired for the protection of T&E species and to guide land management activities to benefit T&E species. Incorporation of this information into map layers that can be manipulated using GIS (Geographic Information Systems) to examine regional patterns of potential habitats and habitat protection needs will assist in the development of an implementation plan for the MSRP. Reduction in habitat quantity and quality are the biggest threats to the biodiversity of South Florida. A key to ensuring protection and recovery of T&E species, and the persistence of all species, is the availability of suitable habitat. With increasing urban and agricultural development, the opportunities for protection of additional land is decreasing. It is more critical than ever to identify, and take steps to protect key lands that will protect not only T&E species, but also other species before they become imperiled. While these models map wildlife species distributions within their range in south Florida, they are not intended as definitive species spatial distributions, but rather as "potential" distributions modeled on available literature, museum records and expert opinion of habitat affinity. The models provide a region wide perspective of potential vertebrate diversity, which can be used for further investigations. The habitat-affinity models rely on associating the potential for a species' presence with specific land covers.

This report documents the models developed for the 22 threatened and endangered terrestrial vertebrate species listed by the MSRP for south Florida. A separate User’s Guide describes the MSRP modeling interface for using both these models and the Florida Gap Analysis Program models along with tools for evaluation of modeled results.

MSRP Threatened and Endangered Vertebrate Models for South Florida

The models follow the methods described in the 2001 Annual Progress Report. Conversion of the models to ArcObjects was a necessary task to keep the models current with the direction of ESRI GIS software development. In general, the object-oriented programming environment allows for considerably improved efficiency, improved ease of updating, and prepares the models for integration into user and management-friendly interfaces.
For each of the 22 modeled species (Table 1), there is a narrative of the model including minimum critical area and dispersal distances if used, a listing of references to habitat used

by the species and a listing of the land cover types selected as used by that species. The land covers are from the Florida GAP classification and are ranked in 4 categories: preferred, suitable, used if adjacent to preferred or suitable habitat, and not used. The definitions of the categories are presented in Table 2. Land cover preferences for each of the modeled species are also presented in Tables 3-5. The land cover classification used as the base for species modeling is the Florida Gap Analysis Program land cover classification of 1993-94 Landsat Thematic Mapper satellite imagery (Figure 2). Figures 2 – 23 present the species ranges and modeled potential habitat for each species.

The MSRP habitat models were peer-reviewed over the summer of 2003 and comments from those reviews have been incorporated to the extent possible. Additional notes associated with the species descriptions will sometimes remark on comments which need further attention. We wish to sincerely thank the following individuals for their participation in the reviews:

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<u>Key Largo Woodrat</u>
Bob McCleery
Roel Lopez
Britt Keith

<u>Wood Stork</u>
Peter Frederick
Wiley Kitchens

<u>Eastern Indigo Snake</u>
Paul Moler
Dave Breininger
Becky Smith

Table 1. Threatened and endangered species modeled.

	Common Name	Taxonomic Name
1	Key Deer	*Odocoileus virginianus clavium*
2	Key Largo Cotton Mouse	*Peromyscus gossypinus allapaticola*
3	Southeastern Beach Mouse	*Peromyscus polionotus niveiventris*
4	Florida Panther	*Puma concolor coryi*
5	Lower Keys Marsh Rabbit	*Sylvilagus palustris hefneri*
6	Silver Rice Rat	*Oryzomys argentatus (recommended) or Oryzomys palustris natator (MSRP)*
7	Key Largo Woodrat	*Neotoma floridana smalli*
8	Audobon's Crested Caracara	*Polyborus plancus audubonii*
9	Bald Eagle	*Haliaeetus leucocephalus*
10	Florida Scrub Jay	*Aphelocoma coerulescens*
11	Everglades Snail Kite	*Rostrhamus sociabilis plumbeus*
12	Piping Plover	*Charadrius melodus*
13	Cape Sable Seaside Sparrow	*Ammodramus maritimus mirabilis*
14	Florida Grasshopper Sparrow	*Ammodramus savannarum floridanus*
15	Wood Stork	*Mycteria americana*
16	Roseate Tern	*Sterna dougallii dougallii*
17	Red Cockaded Woodpecker	*Picoides borealis*
18	American Crocodile	*Crocodylus acutus*
19	Bluetail Mole Skink	*Eumeces egregius lividus*
20	Sand Skink	*Neoseps reynoldsi*
21	Atlantic Salt Marsh Snake	*Nerodia clarkii taeniata*
22	Eastern Indigo Snake	*Drymarchon corais couperi*

Table 2. Definitions of modeled habitat categories.

Preferred habitat: Literature/expert indicates the species is primarily found within these land cover types.

Suitable habitat: Literature/expert uses phasing such as " … the species may also be found in … "

Adjacent habitat: Literature/expert indicates that the species will use these land covers if they are next to preferred or suitable habitat. If these land covers are isolated from preferred or suitable habitat, they will not be modeled as used. Adjacent habitat is defined as being within 180 meters of preferred or suitable habitat unless otherwise stated.

Table 3. Mammal land cover associations. 0 = not used, 1 = adjacent, 2 = suitable, 3 = preferred.

Value	LANDCOVER	Lower Keys Marsh Rabbit	Florida Panther	SE Beach Mouse	Silver Rice Rat	Key Largo Cotton mouse	Key Largo Woodrat	Key Deer
1	Open water	0	0	0	0	0	1	1
2	Tropical Hardwood Hammock Formation	1	3	0	0	3	3	3
3	Semi-deciduous Tropical/Subtropical Swamp Forest	0	3	0	0	2	3	2
4	Xeric-Mesic Live Oak Ecological Complex	0	3	0	0	0	0	3
5	Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex	0	3	0	0	0	0	3
6	Bay/Gum/Cypress Ecological Complex	0	3	0	0	0	0	0
7	Loblolly Bay Forest	0	3	0	0	0	0	0
8	Cajeput Forest Compositional Group	0	3	0	0	0	0	0
9	Mixed Mangrove Forest Formation	1	3	0	3	0	0	1
10	Black Mangrove Forest	1	3	0	3	0	0	1
11	Red Mangrove Forest	1	3	0	3	0	0	1
12	Casuarina Forest	0	3	0	0	0	0	0
13	South Florida Slash Pine Forest	1	3	0	0	0	0	3
14	Sand Pine Forest	0	3	0	0	0	0	3
15	Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex	0	3	0	0	0	0	3
16	Mesic-Hydric Pine Forest Compositional Group	1	3	0	0	0	0	3
17	Swamp Forest Ecological Complex	0	3	0	0	0	0	2
18	Cypress Forest Compositional Group	0	3	0	0	0	0	0
19	Mixed Evergreen.Cold-deciduous Hardwood Forest	0	3	0	0	0	0	3
20	Buttonwood Woodland	2	3	0	1	0	0	3
21	Mixed Mangrove Woodland	1	3	0	3	0	0	1
22	Black Mangrove Woodland	1	3	0	3	0	0	1
23	Red Mangrove Woodland	1	3	0	3	0	0	1
24	Live Oak Woodland	0	3	0	0	0	0	3
25	South Florida Slash Pine Woodland	1	3	0	0	0	0	3
26	Sandhill Ecological Complex	0	3	0	0	0	0	3
27	Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest	0	3	0	0	0	0	3
28	Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest	0	3	0	0	0	0	2
29	Dry Prairie (Xeric-Mesic) Ecological Complex	1	3	1	0	0	0	3
30	Gallberry/Saw Palmetto Shrubland Compositional Group	0	3	0	0	0	0	3
31	Brazilian Pepper Shrubland	0	3	0	0	0	0	0
32	Dwarf Mangrove Ecological Complex	1	3	0	3	0	0	1
33	Coastal Strand	2	3	3	2	2	2	3
34	Groundsel-tree/Marsh Elder Tidal Shrubland	3	3	0	2	0	0	2
35	Xeric Scrubland	0	3	1	0	0	0	3

Table 3 continued. Mammal land cover associations.

Value	LANDCOVER	Lower Keys Marsh Rabbit	Florida Panther	SE Beach Mouse	Silver Rice Rat	Key Largo Cotton mouse	Key Largo Woodrat	Key Deer
36	St. Johns Wort Shrubland Compositional Group	0	3	0	0	0	0	2
37	Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland	0	3	0	0	0	0	2
38	Saltwort/ Glaswort Ecological Complex	1	3	0	3	1	0	2
39	Graminiod Dry Prairie Ecological Complex	1	3	1	0	0	0	3
40	Sea Oats Dune Grassland	0	3	3	0	1	0	0
41	Wiregrass Grassland	3	3	0	0	0	0	3
42	Graminoid Emergent Marsh Compositional Group	3	3	0	3	0	0	2
43	Sawgrass Marsh	3	3	0	3	0	0	2
44	Spikerush Marsh	2	3	0	3	0	0	2
45	Muhly Grass Marsh	3	3	0	3	0	0	2
46	Cattail Marsh Compositional Group	1	3	0	3	0	0	0
47	Salt Marsh Ecological Complex	3	3	0	3	0	0	1
48	Sand Cordgrass Grassland	3	3	0	3	0	0	2
49	Black Needle Rush Marsh	3	3	0	3	0	0	1
50	Saltmarsh Cordgrass Marsh	3	3	0	3	0	0	1
51	Saltmeadow Cordgrass/Salt Grass Salt Marsh	3	3	0	3	0	0	1
52	Sparsely Wooded Wet Prairie Compositional Group	1	3	0	3	0	0	2
53	Dwarf Cypress Prairie	0	3	0	3	0	0	2
54	Temperate Wet Prairie	3	3	0	3	0	0	2
55	Maidencane Marsh	3	3	0	3	0	0	2
56	Forb Emergent Marsh	0	3	0	3	0	0	2
57	Water Lily or Floating Leaved Vegetation	0	0	0	0	0	0	0
58	Periphyton	0	0	0	0	0	0	0
59	Sand, Beach	0	0	1	0	0	0	0
60	Bare Soil/Clearcut	0	0	1	0	0	0	1
61	Pavement, Roadside	1	0	0	0	0	0	0
62	Urban	0	0	0	0	0	1	0
63	Urban Residential	1	0	0	0	0	1	2
64	Urban Open/Others	0	0	0	0	1	1	0
65	Agriculture	0	0	0	0	0	0	0
66	Pasture/Grassland/Agriculture	2	2	0	0	1	0	2
67	Agriculture/Groves/Ornamental	1	0	0	0	0	0	3
68	Agriculture/Confined Feeding Operation/Speciality Farms	0	0	0	0	0	0	0
69	Extractive	0	0	0	0	0	0	0
70	Recreation	0	0	0	0	0	0	1

Table 4**. Bird land cover associations.** 0 = not used, 1 = adjacent, 2 = suitable, 3 = preferred.

Value	LANDCOVER	Cape Sable Seaside Sparrow	Wood Stork	Everglade Snail Kite	Florida Scrub-Jay	Red-cockaded Woodpecker	Florida Grasshopper Sparrow	Audubon Crested Caracara	Piping Plover	Roseate Tern	Bald Eagle
1	Open water	0	1	1	0	0	0	0	0	0	2
2	Tropical Hardwood Hammock Formation	0	0	0	0	0	0	0	0	0	2
3	Semi-deciduous Tropical/Subtropical Swamp Forest	0	2	0	0	1	0	0	0	0	2
4	Xeric-Mesic Live Oak Ecological Complex	0	0	0	1	1	0	0	0	0	2
5	Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex	0	0	0	0	0	0	0	0	0	3
6	Bay/Gum/Cypress Ecological Complex	0	3	0	0	0	0	0	0	0	2
7	Loblolly Bay Forest	0	2	0	0	0	0	0	0	0	2
8	Cajeput Forest Compositional Group	0	0	0	0	0	0	0	0	0	0
9	Mixed Mangrove Forest Formation	0	2	0	0	0	0	0	0	0	3
10	Black Mangrove Forest	0	2	0	0	0	0	0	0	0	3
11	Red Mangrove Forest	0	3	0	0	0	0	0	0	0	3
12	Casuarina Forest	0	1	0	0	0	0	0	0	0	2
13	South Florida Slash Pine Forest	0	0	0	1	3	0	0	0	0	3
14	Sand Pine Forest	0	0	0	1	1	0	0	0	0	0
15	Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex	0	0	0	1	2	0	0	0	0	2
16	Mesic-Hydric Pine Forest Compositional Group	0	0	0	0	3	0	0	0	0	3
17	Swamp Forest Ecological Complex	0	2	0	0	0	0	0	0	0	2
18	Cypress Forest Compositional Group	0	3	0	0	0	0	0	0	0	3
19	Mixed Evergreen.Cold-deciduous Hardwood Forest	0	0	0	0	0	0	0	0	0	3
20	Buttonwood Woodland	0	2	0	0	0	0	0	0	0	0
21	Mixed Mangrove Woodland	0	2	0	0	0	0	0	0	0	0
22	Black Mangrove Woodland	0	2	0	0	0	0	0	0	0	0
23	Red Mangrove Woodland	0	3	0	0	0	0	0	0	0	0
24	Live Oak Woodland	0	0	0	1	0	0	1	0	0	2
25	South Florida Slash Pine Woodland	0	0	0	1	3	0	1	0	0	2
26	Sandhill Ecological Complex	0	0	0	2	3	0	0	0	0	0
27	Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest	0	0	0	0	0	0	0	0	0	2
28	Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest	0	2	0	0	0	0	0	0	0	2
29	Dry Prairie (Xeric-Mesic) Ecological Complex	0	0	0	1	0	3	3	0	0	0
30	Gallberry/Saw Palmetto Shrubland Compositional Group	0	0	0	0	0	0	0	0	0	0
31	Brazilian Pepper Shrubland	0	0	0	0	0	0	0	0	0	0
32	Dwarf Mangrove Ecological Complex	0	2	0	0	0	0	0	0	0	0
33	Coastal Strand	0	1	0	0	0	0	0	0	0	0
34	Groundsel-tree/Marsh Elder Tidal Shrubland	0	0	0	1	0	0	0	0	0	0
35	Xeric Scrubland	0	0	0	3	0	0	1	0	0	0

Table 4 continued. Bird land cover associations.

Value	LANDCOVER	Cape Sable Seaside Sparrow	Wood Stork	Everglade Snail Kite	Florida Scrub-Jay	Red-cockaded Woodpecker	Florida Grasshopper Sparrow	Audubon Crested Caracara	Piping Plover	Roseate Tern	Bald Eagle
36	St. Johns Wort Shrubland Compositional Group	0	0	0	1	0	1	1	0	0	0
37	Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland	0	2	2	0	0	0	0	0	0	0
38	Saltwort/ Glaswort Ecological Complex	0	0	0	0	0	3	0	0	0	0
39	Graminiod Dry Prairie Ecological Complex	0	0	0	1	0	0	3	0	0	0
40	Sea Oats Dune Grassland	0	0	0	0	0	3	0	0	0	0
41	Wiregrass Grassland	0	0	0	1	1	3	2	0	0	0
42	Graminoid Emergent Marsh Compositional Group	0	3	3	0	0	2	2	0	0	2
43	Sawgrass Marsh	0	3	3	0	0	0	2	0	0	2
44	Spikerush Marsh	0	3	3	0	0	0	2	0	0	2
45	Muhly Grass Marsh	3	3	3	0	0	0	2	0	0	2
46	Cattail Marsh Compositional Group	0	2	2	0	0	0	2	0	0	2
47	Salt Marsh Ecological Complex	0	3	0	0	0	0	0	0	0	2
48	Sand Cordgrass Grassland	0	3	0	0	0	0	0	0	0	0
49	Black Needle Rush Marsh	1	3	0	0	0	0	0	0	0	2
50	Saltmarsh Cordgrass Marsh	1	3	0	0	0	0	0	0	0	2
51	Saltmeadow Cordgrass/Salt Grass Salt Marsh	0	3	0	0	0	0	0	0	0	2
52	Sparsely Wooded Wet Prairie Compositional Group	0	2	3	0	0	1	0	0	0	2
53	Dwarf Cypress Prairie	0	2	3	0	0	0	0	0	0	2
54	Temperate Wet Prairie	0	3	3	0	0	1	2	0	0	2
55	Maidencane Marsh	0	3	3	0	0	0	2	0	0	2
56	Forb Emergent Marsh	0	3	1	0	0	0	0	0	0	2
57	Water Lily or Floating Leaved Vegetation	0	1	1	0	0	0	0	0	0	2
58	Periphyton	0	1	0	0	0	0	0	0	0	0
59	Sand, Beach	0	0	0	0	0	0	0	3	3	0
60	Bare Soil/Clearcut	0	0	0	0	0	0	0	0	2	0
61	Pavement, Roadside	0	0	0	0	0	0	0	0	0	0
62	Urban	0	0	0	0	0	0	0	0	0	0
63	Urban Residential	0	0	0	0	0	0	0	0	0	0
64	Urban Open/Others	0	0	0	0	0	0	0	0	0	0
65	Agriculture	0	0	0	0	0	0	0	0	0	0
66	Pasture/Grassland/Agriculture	0	0	0	0	0	2	3	0	0	2
67	Agriculture/Groves/Ornamental	0	0	0	0	0	0	0	0	0	0
68	Agriculture/Confined Feeding Operation/Speciality Farms	0	0	0	0	0	0	0	0	0	0
69	Extractive	0	0	0	0	0	0	0	0	0	0
70	Recreation	0	0	0	1	0	0	0	0	0	0

Table 5**. Reptile land cover associations.** 0 = not used, 1 = adjacent, 2 = suitable, 3 = preferred.

Value	LANDCOVER	Atlantic Salt Marsh Snake	Bluetail Mole Skink	Eastern Indigo Snake	American Crocodile	Sand Skink
1	Open water	0	0	0	1	0
2	Tropical Hardwood Hammock Formation	0	0	3	0	0
3	Semi-deciduous Tropical/Subtropical Swamp Forest	0	0	1	1	0
4	Xeric-Mesic Live Oak Ecological Complex	0	3	3	0	1
5	Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex	0	0	3	0	0
6	Bay/Gum/Cypress Ecological Complex	0	0	1	0	0
7	Loblolly Bay Forest	0	0	1	0	0
8	Cajeput Forest Compositional Group	0	0	1	0	0
9	Mixed Mangrove Forest Formation	2	0	1	3	0
10	Black Mangrove Forest	2	0	1	3	0
11	Red Mangrove Forest	2	0	1	3	0
12	Casuarina Forest	0	0	0	0	0
13	South Florida Slash Pine Forest	0	0	3	0	0
14	Sand Pine Forest	0	2	3	0	2
15	Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex	0	2	3	0	0
16	Mesic-Hydric Pine Forest Compositional Group	0	0	3	0	0
17	Swamp Forest Ecological Complex	0	0	1	1	0
18	Cypress Forest Compositional Group	0	0	1	0	0
19	Mixed Evergreen.Cold-deciduous Hardwood Forest	0	0	1	0	0
20	Buttonwood Woodland	2	0	3	3	0
21	Mixed Mangrove Woodland	2	0	1	3	0
22	Black Mangrove Woodland	2	0	1	3	0
23	Red Mangrove Woodland	2	0	1	3	0
24	Live Oak Woodland	0	2	3	0	0
25	South Florida Slash Pine Woodland	0	0	3	0	0
26	Sandhill Ecological Complex	0	2	3	0	3
27	Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest	0	0	3	0	0
28	Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest	0	0	1	2	0
29	Dry Prairie (Xeric-Mesic) Ecological Complex	0	0	3	0	0
30	Gallberry/Saw Palmetto Shrubland Compositional Group	0	0	3	0	1
31	Brazilian Pepper Shrubland	0	0	1	0	0
32	Dwarf Mangrove Ecological Complex	2	0	1	1	0
33	Coastal Strand	0	0	3	0	0
34	Groundsel-tree/Marsh Elder Tidal Shrubland	0	0	1	0	0
35	Xeric Scrubland	0	3	3	0	3

Table 5 continued. Reptile land cover associations.

Value	LANDCOVER	Atlantic Salt Marsh Snake	Bluetail Mole Skink	Eastern Indigo Snake	American Crocodile	Sand Skink
36	St. Johns Wort Shrubland Compositional Group	0	0	1	0	1
37	Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland	0	0	1	1	0
38	Saltwort/ Glaswort Ecological Complex	2	0	0	0	0
39	Graminiod Dry Prairie Ecological Complex	0	0	3	0	0
40	Sea Oats Dune Grassland	0	0	1	0	0
41	Wiregrass Grassland	0	0	3	0	0
42	Graminoid Emergent Marsh Compositional Group	0	0	0	0	0
43	Sawgrass Marsh	0	0	0	0	0
44	Spikerush Marsh	0	0	0	0	0
45	Muhly Grass Marsh	0	0	0	0	0
46	Cattail Marsh Compositional Group	0	0	0	0	0
47	Salt Marsh Ecological Complex	3	0	0	0	0
48	Sand Cordgrass Grassland	0	0	0	0	0
49	Black Needle Rush Marsh	3	0	0	0	0
50	Saltmarsh Cordgrass Marsh	3	0	0	0	0
51	Saltmeadow Cordgrass/Salt Grass Salt Marsh	3	0	0	0	0
52	Sparsely Wooded Wet Prairie Compositional Group	0	0	1	0	0
53	Dwarf Cypress Prairie	0	0	1	0	0
54	Temperate Wet Prairie	0	0	1	0	0
55	Maidencane Marsh	0	0	1	0	0
56	Forb Emergent Marsh	0	0	0	0	0
57	Water Lily or Floating Leaved Vegetation	0	0	0	0	0
58	Periphyton	0	0	0	0	0
59	Sand, Beach	0	0	1	1	1
60	Bare Soil/Clearcut	0	2	0	0	1
61	Pavement, Roadside	0	0	0	0	0
62	Urban	0	0	0	0	0
63	Urban Residential	0	0	0	0	0
64	Urban Open/Others	0	0	0	1	0
65	Agriculture	0	0	1	0	0
66	Pasture/Grassland/Agriculture	0	0	1	0	0
67	Agriculture/Groves/Ornamental	0	0	1	0	0
68	Agriculture/Confined Feeding Operation/Speciality Farms	0	0	0	0	0
69	Extractive	0	0	0	0	0
70	Recreation	0	0	1	0	0

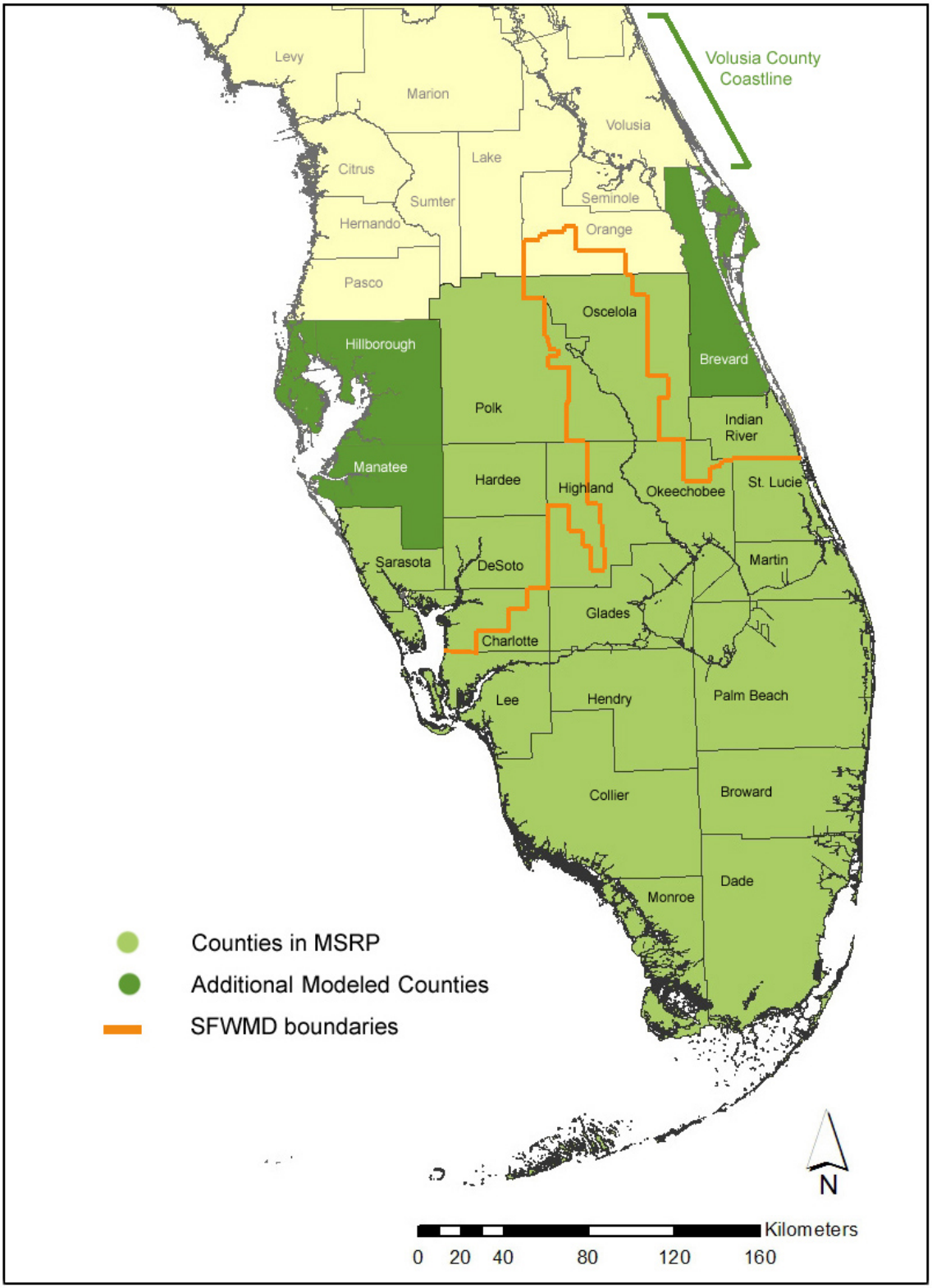

Figure 1. Area of the South Florida Multi-Species Recovery Plan and additional area included in the models.

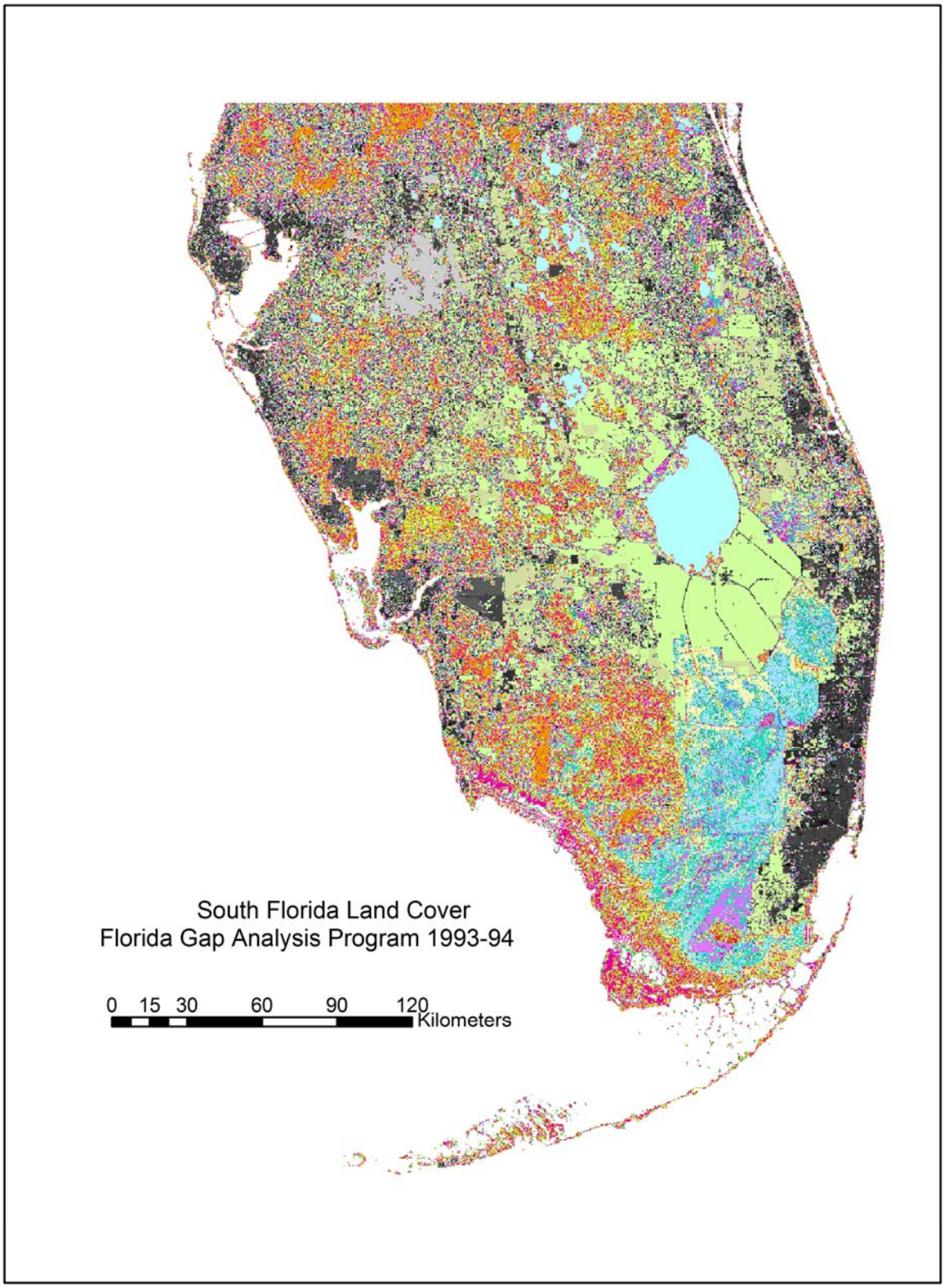

Figure 2. Land cover classification of South Florida. Florida Gap Analysis Program.

South Florida Land Cover
Florida Gap Analysis Program 1993-94

Legend

Land Cover

- Background
- Open water
- Tropical Hardwood Hammock Formation
- Semi-deciduous Tropical/Subtropical Swamp Forest
- Xeric-MesicLive Oak Ecological Complex
- Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex
- Bay/Gum/Cypress Ecological Complex
- Cajeput Forest Compositional Group
- Mixed Mangrove Forest Formation
- Black Mangrove Forest
- Red Mangrove Forest
- Casuarina Forest
- South Florida Slash Pine Forest
- Sand Pine Forest
- Mesic-Hydric Pine Forest Compositional Group
- Swamp Forest Ecological Complex
- Cypress Forest Compositional Group
- Mixed Evergreen.Cold-deciduous Hardwood Forest
- Buttonwood Woodland
- Mixed Mangrove Woodland
- Black Mangrove Woodland
- Red Mangrove Woodland
- Live Oak Woodland
- South Florida Slash Pine Woodland
- Sandhill Ecological Complex
- Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest
- Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest
- Dry Prairie (Xeric-Mesic) Ecological Complex
- Gallberry/Saw Palmetto Shrubland Compositional Group
- Brazilian Pepper Shrubland
- Dwarf Mangrove Ecological Complex
- Coastal Strand
- Groundsel-tree/Marsh Elder Tidal Shrubland
- Xeric Scrubland
- St. Johns Wort Shrubland Compositional Group
- Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
- Saltwort/ Glaswort Ecological Complex
- Graminiod Dry Prairie Ecological Complex
- Sea Oats Dune Grassland
- Wiregrass Grassland
- Graminoid Emergent Marsh Compositional Group
- Sawgrass Marsh
- Spikerush Marsh
- Muhly Grass Marsh
- Cattail Marsh Compositional Group
- Salt Marsh Ecological Complex
- Sand Cordgrass Grassland
- Black Needle Rush Marsh
- Saltmarsh Cordgrass Marsh
- Sparsely Wooded Wet Prairie Compositional Group
- Dwarf Cypress Prairie
- Temperate Wet Prairie
- Maidencane Marsh
- Forb Emergent Marsh
- Water Lily or Floating Leaved Vegetation
- Sand, Beach
- Bare Soil/Clearcut
- Pavement, Roadside
- Urban
- Urban Residential
- Urban Open/Others
- Agriculture
- Pasture/Grassland/Agriculture
- Agriculture/Groves/Ornamental
- Agriculture/Confined Feeding Operation/Speciality Farms
- Extractive
- Recreation
- Cloud

Figure 2 continued. Legend for the Florida Gap Analysis Program Land Cover Classification.

Mammals

Key Deer
Odocoileus virginianus clavium

Habitat references:
Variety, flatwoods, swamps, hammocks, marshes with tree islands, pinelands, wet prairie, willow heads, grassy areas along beaches, mangroves, and disturbed (Layne 1984).
Key deer found on Big Johnson, Little Pine, No Name, Big Pine, Big Torch, Middle Torch, Little Torch, Cudjoe, Howe, Sugarloaf, Knockemdown, and Summerland Keys. Pinelands and hardwoods, fresh water availability is a must. Also open areas, mangrove, and buttonwood. During wet periods, deer may spread out to those keys above that do not possess permanent water resources. Pinelands, without dense palm understory, are important. Do just fine in subdivisions (Klimstra 1992).
In northwest Everglades, south BCNP, hardwood tree islands, hardwood scrub preferred, and wet prairie and dwarf cypress avoided (Miller 1993).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992). The species range (Humphrey, 1992) is limited to the lower keys from Boca Chica Key to the Johnson keys (Figure 3).

2. Within the range of Key Deer, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
2-Tropical Hardwood Hammock Formation
4-Xeric-Mesic Live Oak Ecological Complex
5-Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex
13-South Florida Slash Pine Forest
14-Sand Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex
16-Mesic-Hydric Pine Forest Compositional Group
19-Mixed Evergreen.Cold-deciduous Hardwood Forest
20-Buttonwood Woodland
24- Live Oak Woodland
25-South Florida Slash Pine Woodland
26-Sandhill Ecological Complex
27-Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest
29-Dry Prairie (Xeric-Mesic) Ecological Complex
30-Gallberry/Saw Palmetto Shrubland Compositional Group
33-Coastal Strand
35-Xeric Scrubland
39-Graminiod Dry Prairie Ecological Complex
41-Wiregrass Grassland
67-Agriculture/Groves/Ornamental

FL GAP land cover classes modeled as **suitable habitat** are:
3-Semi-deciduous Tropical/Subtropical Swamp Forest
17-Swamp Forest Ecological Complex
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest
34-Groundsel-tree/Marsh Elder Tidal Shrubland
36-St. Johns Wort Shrubland Compositional Group
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
38-Saltwort/ Glaswort Ecological Complex
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
48-Sand Cordgrass Grassland
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh
56-Forb Emergent Marsh
63-Urban Residential
66-Pasture/Grassland/Agriculture

FL GAP land cover classes modeled as **adjacent habitat** are:
1-Open water
9-Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland
32-Dwarf Mangrove Ecological Complex
46-Cattail Marsh Compositional Group
47-Salt Marsh Ecological Complex
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
57-Water Lily or Floating Leaved Vegetation
60-Bare Soil/Clearcut
70-Recreation

3. All contiguous areas of habitat are considered viable for the Key Deer. No minimum critical area was modeled (Figure 3).

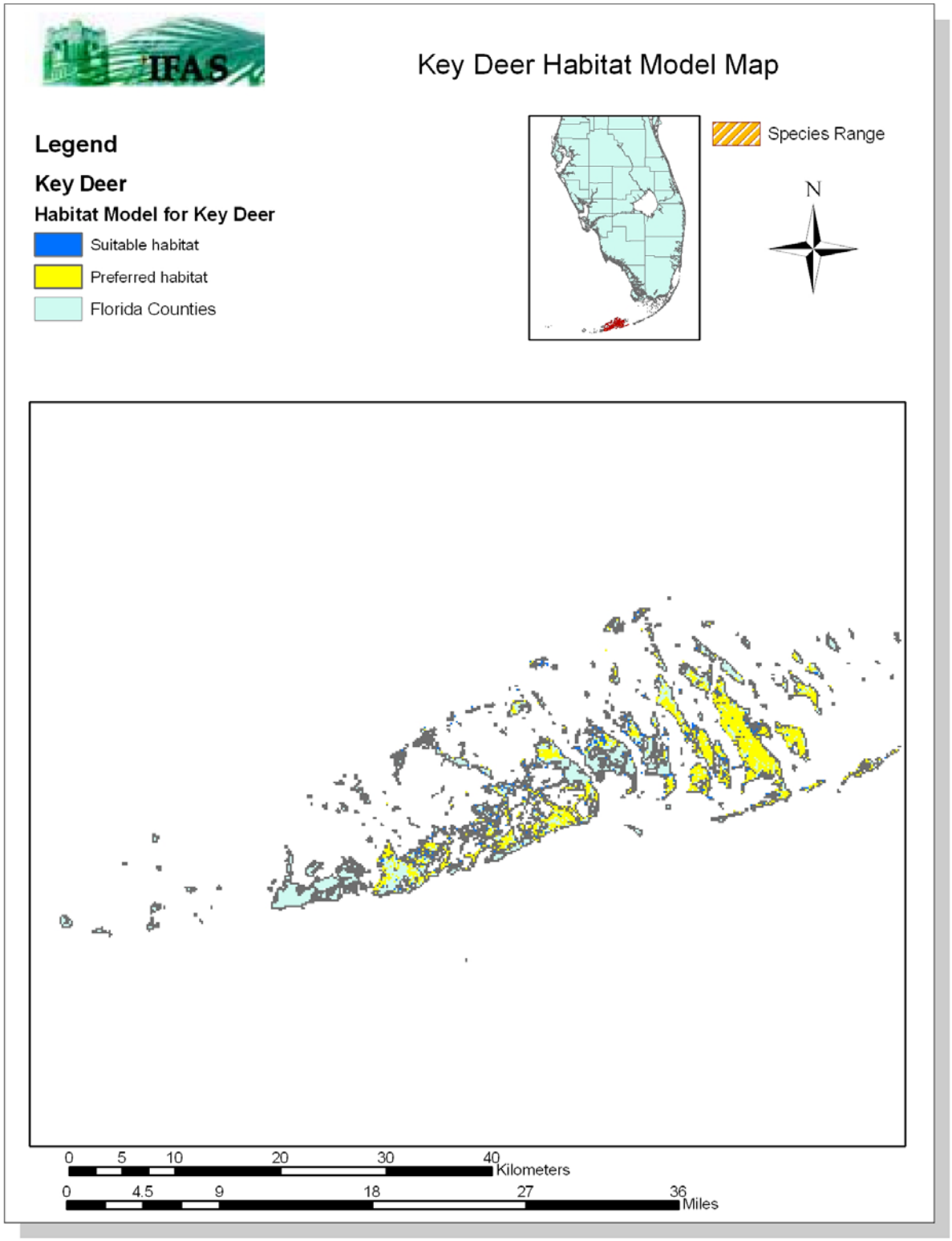

Figure 3. Modeled habitat for the Key Deer**,** *Odocoileus virginianus clavium*

Key Largo Cotton Mouse
Peromyscus gossypinus allapaticola

Habitat references:
Prefers tropical hardwood hammock, but will also use adjacent (<= 180 m) saltwort/glasswort communities and open disturbed areas (Humphrey, pers. comm., 2001).
Subspecies is the beach cotton mice, found in closed canopy forests and grasslands adjacent to coastal forest [e.g. sea oats] (Humphrey 1992)
Key Largo cotton mouse found in tropical hardwoods on Key Largo. Formerly to Plantation Key, now probably restricted to north half of Largo. Deciduous dry tropical forest. All successional stages, and also in Salicornia coastal strand adjacent to forest (Humphrey 1992).
Bottomland hardwoods, mesic and hydric hammocks, swamps, and also margins of cleared fields, edges of salt savannah, palmetto thickets bordering beaches, dry hammocks, beach dunes, pine flatwoods, upland woods, pine/hardwood forests, pine/turkey oak, and sand pine scrub. May be most common in areas subject to periodic flooding (Wolfe 1977).
Present in ""burned over habitats"" which are marginal for woodrats (Lazell 1989).
In Key Largo, only mature tropical hardwood with deep leaf litter. More restricted to mature forest than N. smalli (Barbour and Humphrey 1982).
Common in coastal scrub (Fernald 1989).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992). The species range in Humphrey (1992) is limited to the portion of Key Largo north of US1, however, the modeled range is all of Key Largo including the several keys just north of Key Largo (Figure 4) based on reviewers comments on the potential that these areas support or could support the species.

2. Within the range of Key Largo Cotton Mouse, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
2-Tropical Hardwood Hammock Formation

FL GAP land cover classes modeled as **suitable habitat** are:
3-Semi-deciduous Tropical/Subtropical Swamp Forest
33-Coastal Strand

FL GAP land cover classes modeled as **adjacent habitat** are:
38-Saltwort/ Glaswort Ecological Complex
40-Sea Oats Dune Grassland
64-Urban Open/Others
66-Pasture/Grassland/Agriculture

3. No minimum critical area was modeled for the Key Largo Cotton Mouse (Figure 4).

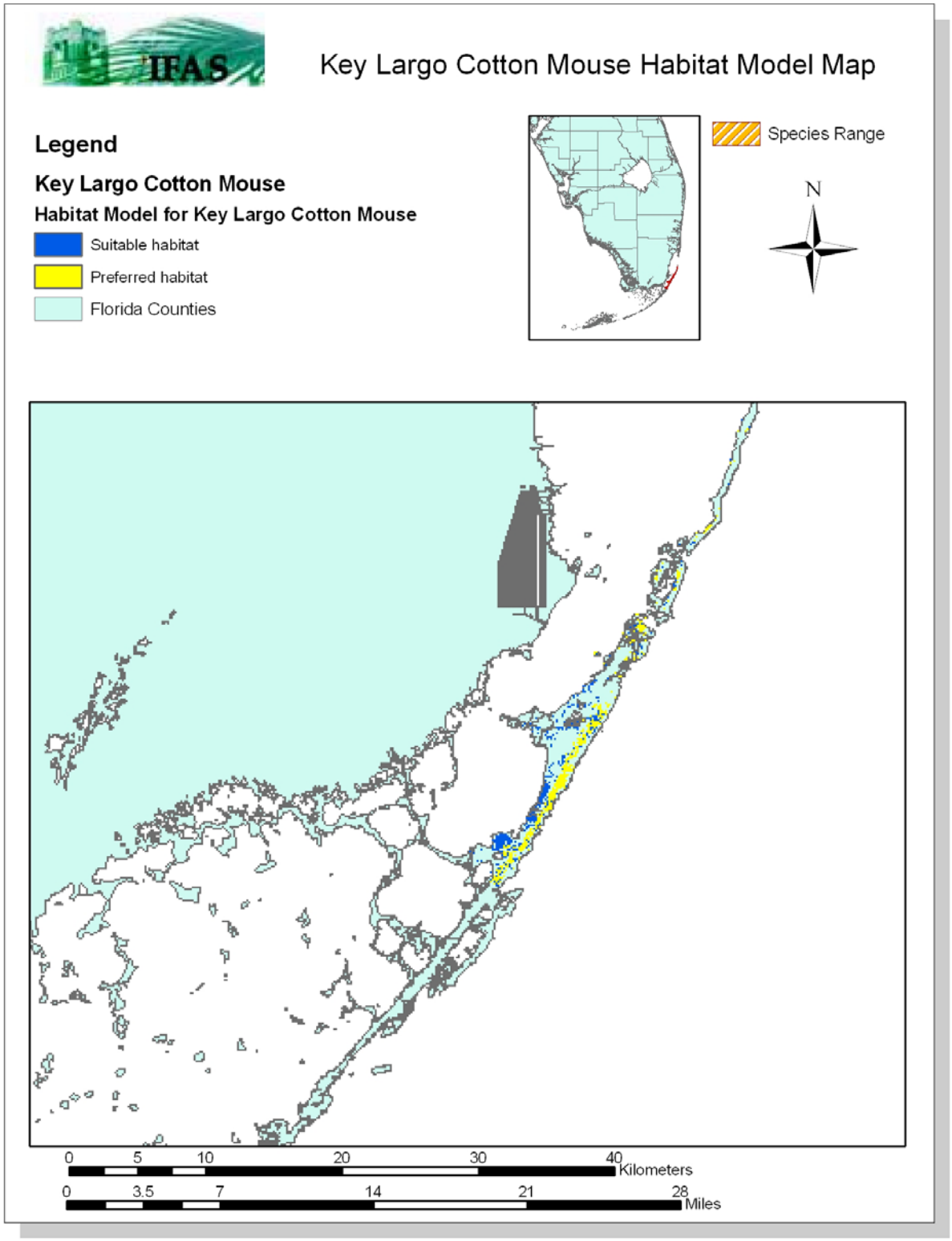

Figure 4. Modeled habitat for the Key Largo Cotton Mouse, *Peromyscus gossypinus allapaticola*

Southeastern Beach Mouse
Peromyscus polionotus niveiventris

Habitat References:
Prefers coastal berm and sea oats dune communities (Humphrey, pers. comm., 2001). Southeastern beach mouse's primary habitat are dunes with sea oats and scrub (Layne 1984). Grassland and open sandy/shrubby areas may be occupied, but south of Canaveral most or all are in sea oats area only (Stout in Humphrey 1992).

1. The species range (Humphrey, 1992) extends from south of Ponce Inlet in Volusia County to Hollywood Beach in Broward County (Figure 5).

2. Within the range of Southeastern Beach Mouse, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
33-Coastal Strand
40-sea oats and dune grassland

FL GAP land cover classes modeled as **adjacent habitat** (within 1500m of preferred habitat) are:
29-Dry Prairie (Xeric-Mesic) Ecological Complex
35-Xeric Scrubland
39-Graminiod Dry Prairie Ecological Complex
59-Sand, Beach
60-Bare Soil/Clearcut

3. No minimum critical area was modeled for the Southeastern Beach Mouse (Figure 5).

Additional Notes:
The identification of additional habitats as adjacent could involve several options. First, any of the cover types mentioned above as potential suitable or adjacent habitat should be identified as habitat when they are adjacent to primary habitat (sea oats/dune grassland or coastal strand). The second option is to identify any of the proposed secondary cover types as habitat when they are within an accepted distance (1-2 km) of primary habitat. The second option was selected for the MSRP model used here (Figure 5). A distance of 1500 m was used. The third option would be to only use the second option within the boundaries of the Cape Canaveral NS/Merritt Island NWR, since this appears to be the only location where the subspecies has been confirmed away from primary dunes and coastal strand. Fourth, a more complicated GIS procedure could be developed to identify all secondary habitats within a set distance of primary dunes/coastal strand that were also connected to these areas by suitable "matrix habitat". Coding for this option exist from a Geoplan model for gopher frogs (which use upland habitats connected to suitable breeding wetlands), but has not been implemented as an option for the Southeastern Beach Mouse.

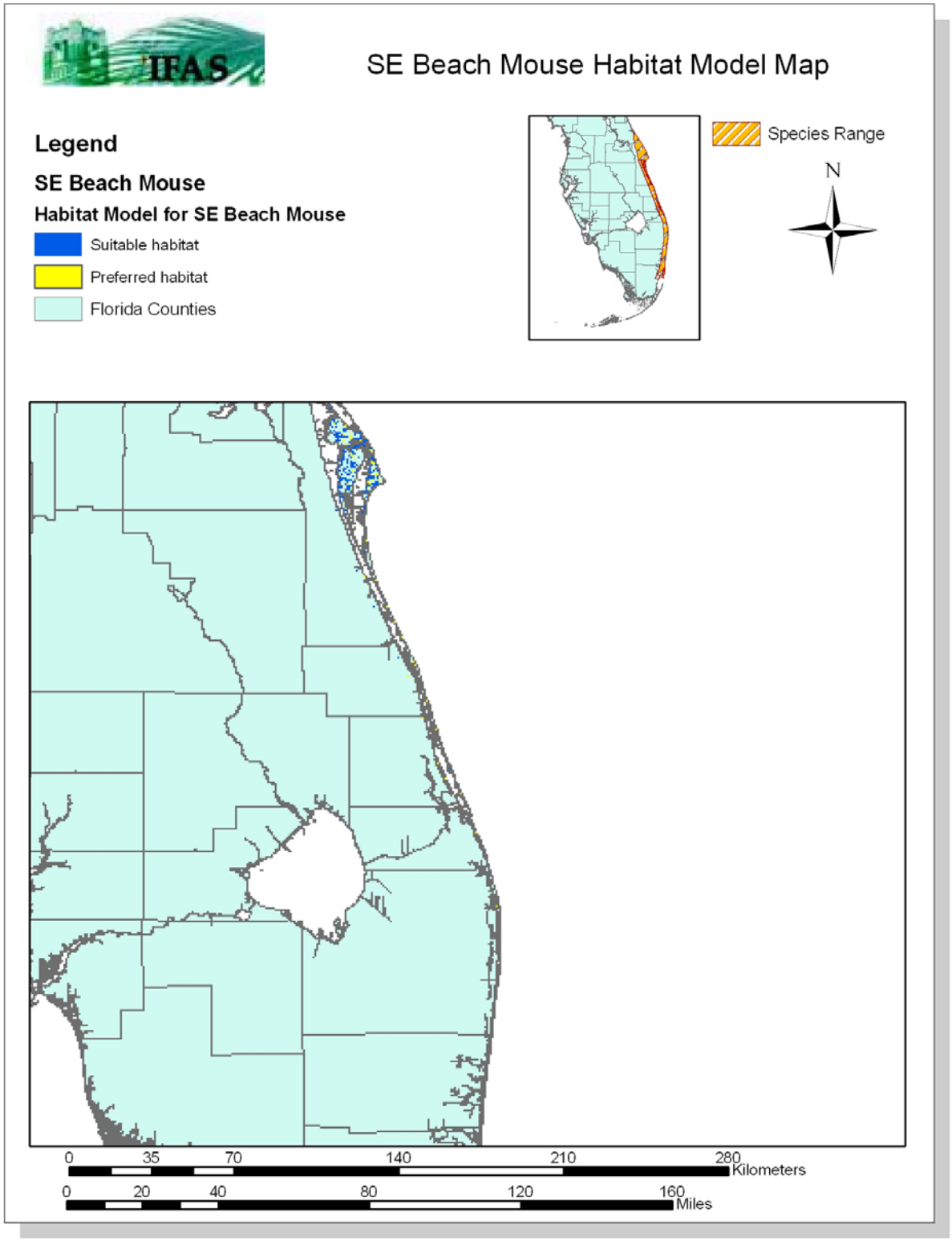

Figure 5. Modeled habitat for the Southeastern Beach Mouse, *Peromyscus polionotus niveiventris*

Florida Panther
Puma concolor coryi

Habitat references:
Broad, found in tropical hammocks, pine flatwoods, cabbage palm, mixed swamp, cypress swamp, live oak hammock, sawgrass, and brazilian pepper, among others. During day, thick areas, for example saw palmetto. Home range 200 square km for females, 400 square km for males (Maehr 1992).
Reported from every major habitat association in Florida; no established habitat preference. In southwest, recorded from hammocks, suburban, mixed scrub, pine flatwoods, and mixed pine/hardwoods, Australian pine/mangrove, groves, hydric hammock, longleaf pine flatwoods, longleaf pine/turkey oak, scrub palmetto, swamps, sloughs, lake shore, tallgrass pasture, and riverine forest (Layne et al. 1977).
Variety of habitats, very mobile. In Everglades National Park, 15 of 19 sightings in mangrove zone, rest in glades with tree islands, pine forest, and disturbed areas (Layne 1984). Especially hardwood hammock, pine flatwoods, cabbage palm, and cypress swamp. Average home range for females is 191 km, males 558 km (Maehr 1990).
Home range 100 square km for females, 500 square km for males. Hardwood hammock, hardwood/pine, fresh marsh, cypress swamp, and hardwood swamp. Hardwood hammock and swamp correlate with smaller home ranges. Pine forest and cypress swamp negatively correlated with frequency of relocation; contradicts earlier Maehr analysis. Hardwood hammocks preferred. Avoid barren, shrub, freshwater marsh. No patches defined by state/federal highways less than 100 square km that contain cats. All greater than 3000 square km that do contain cats. One thousand square km of road defined patches may be minimum - excluding conservation area two (Maehr 1992).
Mixed swamp forests and hammock forests (Belden et al. 1988).
Female density based on prey abundance, habitat, male abundance on availability of females; females not territorial but socially intolerant. Author suggests 1000-2200 square km connected habitat needed for minimum viable populations - 0.98*100 years; no genetic consideration (Beier 1993).

1. The species range (Humphrey, 1992) extends from the southern edge of the Everglades to just north of Lake Okechobee (Figure 6).

2. Within the range of the Florida Panther, land cover types were identified as:

FL GAP land cover classes modeled as **forested habitat** are:
2-Tropical Hardwood Hammock Formation
3-Semi-deciduous Tropical/Subtropical Swamp Forest
4-Xeric-Mesic Live Oak Ecological Complex
5-Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex
6-Bay/Gum/Cypress Ecological Complex
7-Loblolly Bay Forest
13-South Florida Slash Pine Forest
14-Sand Pine Forest

15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex
16-Mesic-Hydric Pine Forest Compositional Group
17-Swamp Forest Ecological Complex
18-Cypress Forest Compositional Group
19-Mixed Evergreen.Cold-deciduous Hardwood Forest
24-Live Oak Woodland
25-South Florida Slash Pine Woodland
26-Sandhill Ecological Complex
30-Gallberry/Saw Palmetto Shrubland Compositional Group
53-Dwarf Cypress Prairie

FL GAP land cover classes modeled as **additional habitat** are:
8-Cajeput Forest Compositional Group
9-Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
12-Casuarina Forest20-23
27-Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest
29-Dry Prairie (Xeric-Mesic) Ecological Complex
30-Gallberry/Saw Palmetto Shrubland Compositional Group
31-Brazilian Pepper Shrubland
32-Dwarf Mangrove Ecological Complex
33-Coastal Strand
34-Groundsel-tree/Marsh Elder Tidal Shrubland
35-Xeric Scrubland
36-St. Johns Wort Shrubland Compositional Group
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
38-Saltwort/ Glaswort Ecological Complex
39-Graminiod Dry Prairie Ecological Complex
40-Sea Oats Dune Grassland
41-Wiregrass Grassland
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group
47-Salt Marsh Ecological Complex
48-Sand Cordgrass Grassland
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
52-Sparsely Wooded Wet Prairie Compositional Group
54-Temperate Wet Prairie
55-Maidencane Marsh
56-Forb Emergent Marsh

66-Pasture/Grassland/Agriculture

3. Forested habitat greater than 2ha (core forested habitat) was accepted as habitat. Any forested or additional habitat within 200m of the core forested habitat was also accepted as habitat.

4. Any selected habitat within 300m of urban areas was excluded.

5. All natural land cover types listed above were mapped as **preferred habitat**. Class 66, Pasture/Grassland/Agriculture, was mapped as **suitable habitat** (Figure 6).

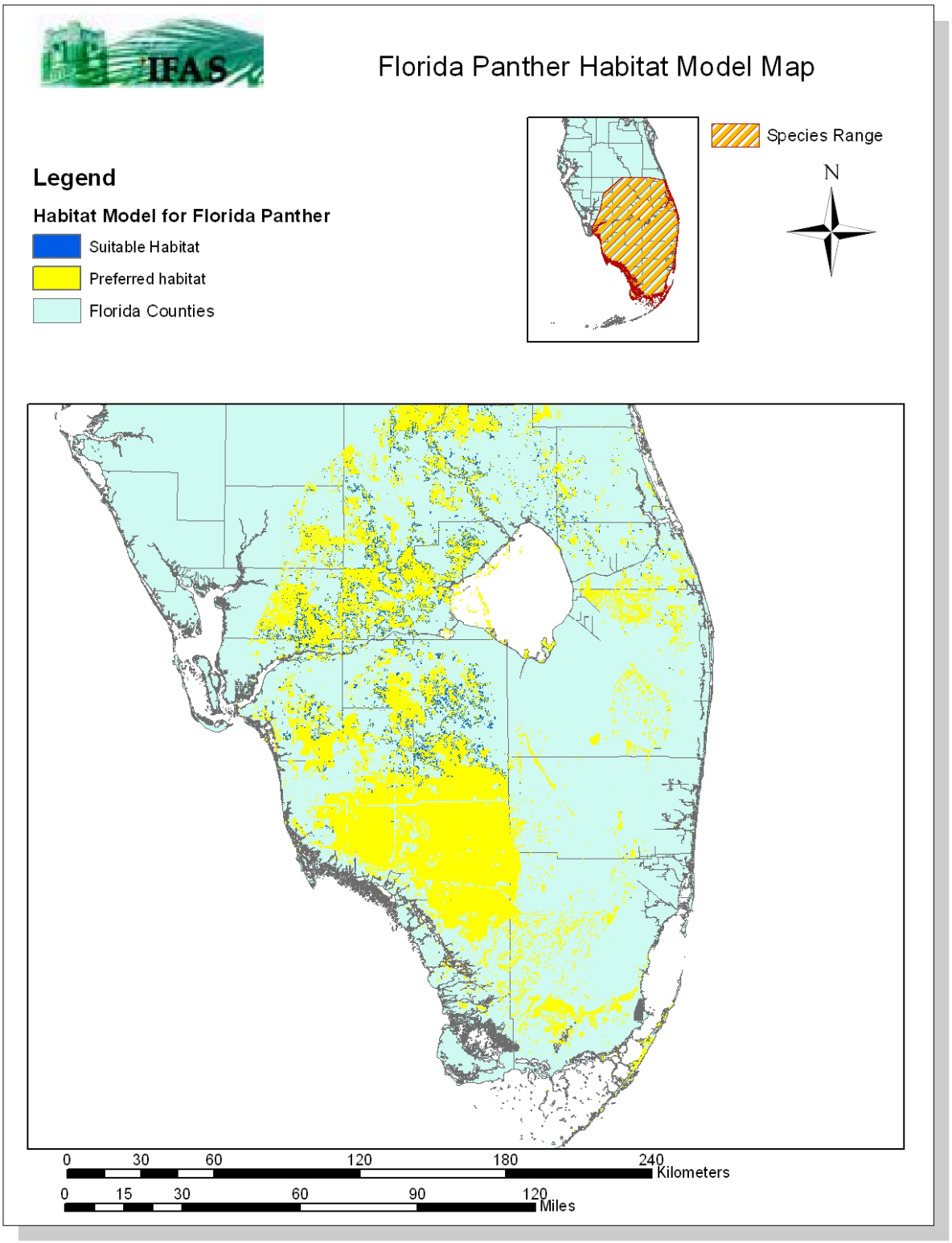

Figure 6. Modeled habitat for Florida Panther, *Puma concolor coryi*

Lower Keys Marsh Rabbit
Sylvilagus palustris hefneri

Habitat references:
Lower Keys. Several keys from Big Pine to Boca Chica. Big Pine, Hopkins, Sugarloaf, Welles, Saddlebunch, Geiger, and Boca Chica. Marshes, adjacent low herbaceous growth, sedges, and grasses. Also grassy fields and tropical hammocks (Wolfe 1992).
Prefers dry prairie and fresh and saltwater marsh communities, but also will use adjacent (< = 180 m) mangrove and pine forest communities (Forys, 1995).
Marshy habitats, brackish and fresh, also recorded in mesic hammock. Limited by availability of water. (Chapman and Willner 1981).
Broad, generally wet areas with dense cover, however may vary from xeric to hydric. Sand pine scrub, pine flatwoods, mangroves, freshwater marshes, old fields, and along vegetated ditches (Layne et al. 1977).
Most major habitat types in south Florida. Freshwater sawgrass with tree islands, fresh water prairies, salt water marsh and prairie, swamps, mangroves, buttonwood, tropical hammock, willow head, dwarf cypress, beaches, dunes, fallow tomato fields, dense vegetation in ditches and canals, and field and road edges. May be rare or absent in pinelands (Layne 1984).
Hammocks near Cape Sable, saw grass, and edges of mangrove swamp (Blair 1935).
Shrubs and weed thickets bordering ponds (Moore 1946).
Salt marshes, especially Spartina bordering slight elevations. Also freshwater marsh at edge of flatwoods and hammocks (Ivey 1959).
Associated with water. Hammock, low pineland, near ponds, cattails, broomsedge. Need available cover, cattails, briars, etc (Blair 1936)

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992 The species range (Humphrey, 1992) is limited to the lower keys between Big Pine Key and Boca Chica Key (Figure 7).

2. Within the range of Lower Keys Marsh Rabbit, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
34-Groundsel-tree/Marsh Elder Tidal Shrubland
41-Wiregrass Grassland
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
45-Muhly Grass Marsh
47-Salt Marsh Ecological Complex
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
54-Temperate Wet Prairie
55-Maidencane Marsh

FL GAP land cover classes modeled as **suitable habitat** are:
20-Buttonwood Woodland
33-Coastal Strand
44-Spikerush Marsh
66- Pasture/Grassland/Agriculture

FL GAP land cover classes modeled as **adjacent habitat** are:
2-Tropical Hardwood Hammock Formation
9-Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
13-South Florida Slash Pine Forest
16-Mesic-Hydric Pine Forest Compositional Group
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland
25-South Florida Slash Pine Woodland
29-Dry Prairie (Xeric-Mesic) Ecological Complex
32-Dwarf Mangrove Ecological Complex
38-Saltwort/ Glaswort Ecological Complex
39-Graminiod Dry Prairie Ecological Complex
46-Cattail Marsh Compositional Group
48-Sand Cordgrass Grassland
52-Sparsely Wooded Wet Prairie Compositional Group
61-Pavement, Roadside
63-Urban Residential
67-Agriculture/Groves/Ornamental

3. No minimum critical area was modeled for the Lower Keys Marsh Rabbit (Figure 7).

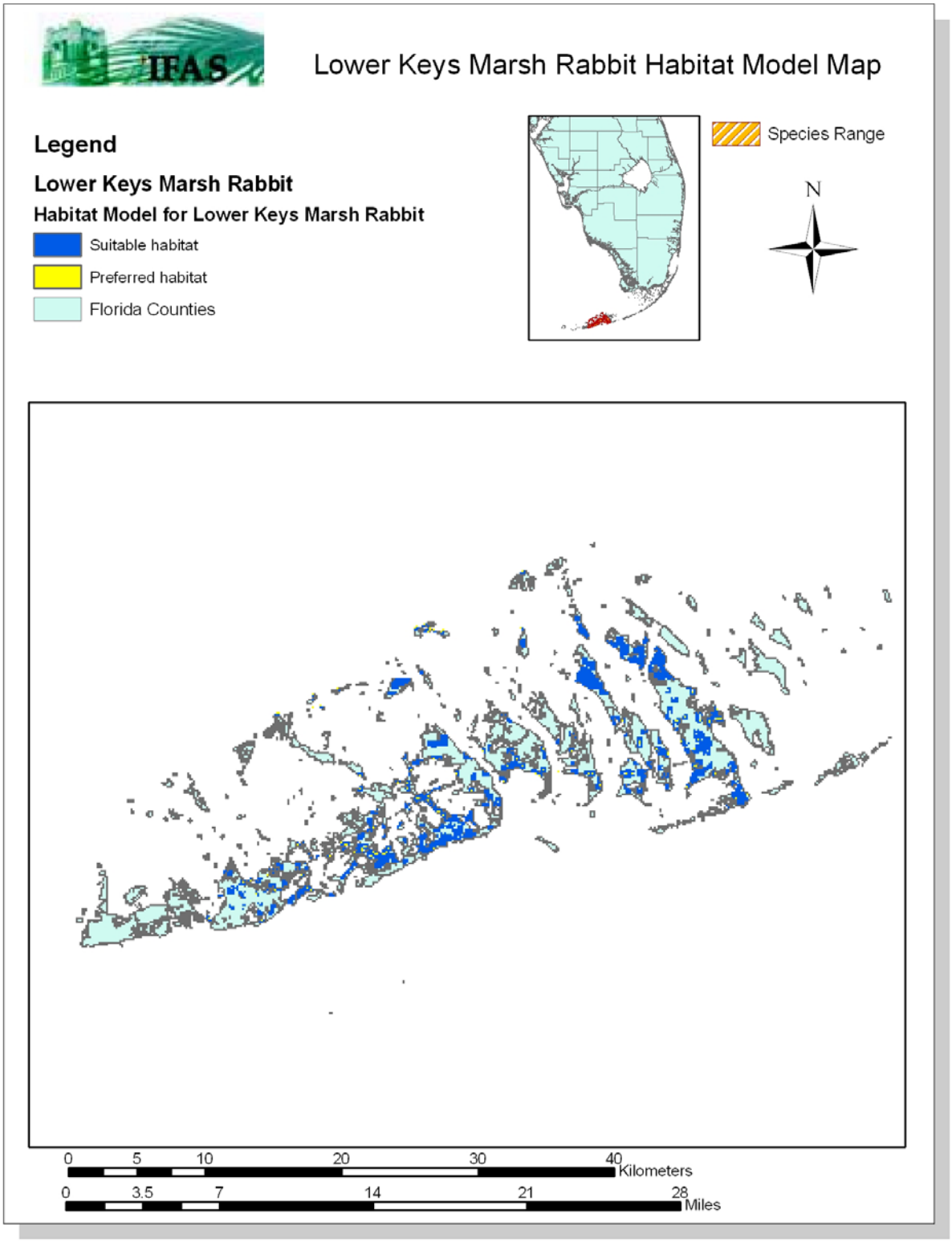

Figure 7. Modeled habitat for Lower Keys Marsh Rabbit**,** *Sylvilagus palustris hefneri*

Silver Rice Rat
Listed as *Oryzomys palustris natator* by MSRP.
Oryzomys argentatus has been recommended based on Goodyear (1991).

Habitat references:
Lower keys populations, upland to marine interface, including buttonwood transition, salt flats, coastal strand, freshwater marsh, and upslope face of black mangrove. Most abundant in tidal marsh. Home range approximately 23 ha {based on a single male; highly questionable!}. Saltwort extensively eaten and indicative of good habitat (Humphrey 1992).
Coastal marshes, also hydric hammocks, swamps, freshwater marshes, and meadows (Wolfe 1982).
Cudjoe Key, Raccoon Key, Summerland, and Middle Torch. Salt marsh, transition zones, freshwater marsh, and cattails (Lazell 1989).
Range includes Sanibel and Captiva Islands. Marshes and hammocks, especially in high water. Wet lowlands, sawgrass along canals, willow heads, elevated roadways through wet glades, wet marsh prairie, grasslands, and tropical hammock. Keys and Sanibel Island subspecies in marshes with abundant cattails (Layne 1984).
Near flatwoods ponds, and nests in maidencane, shrubs, and rushes (Moore 1946).
Trapped only in salt marsh in Gulf Hammock area (Pearson 1954).
Offshore keys, nesting in hollow black mangrove (Fargo 1929).
Captured on Big Torch, Cudjoe, Johnston, Little Pine, Middle Torch, Raccoon, Saddlebunch, Summerland, and Water keys. All captured at salt marsh or immediately adjacent.
Telemetry revealed use of intertidal mangroves, salt marsh, and buttonwood (Goodyear 1987).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992). The species occupied range is limited to the lower keys in Humphrey (1992). Its potential range was added to the models and includes Boca and Johnson Keys (Figure 8).

2. Within the range of Silver Rice Rat, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
9-Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland
32-Dwarf Mangrove Ecological Complex
38-Saltwort/ Glaswort Ecological Complex
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh

45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group
47-Salt Marsh Ecological Complex
48-Sand Cordgrass Grassland
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh
56-Forb Emergent Marsh47-Salt Marsh Ecological Complex
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh

FL GAP land cover classes modeled as **suitable habitat** are:
33-Coastal Strand
34-Groundsel-tree/Marsh Elder Tidal Shrubland

FL GAP land cover classes modeled as **adjacent habitat** are:
20-Buttonwood Woodland

3. No minimum critical area was modeled for the Silver Rice Rat (Figure 8).

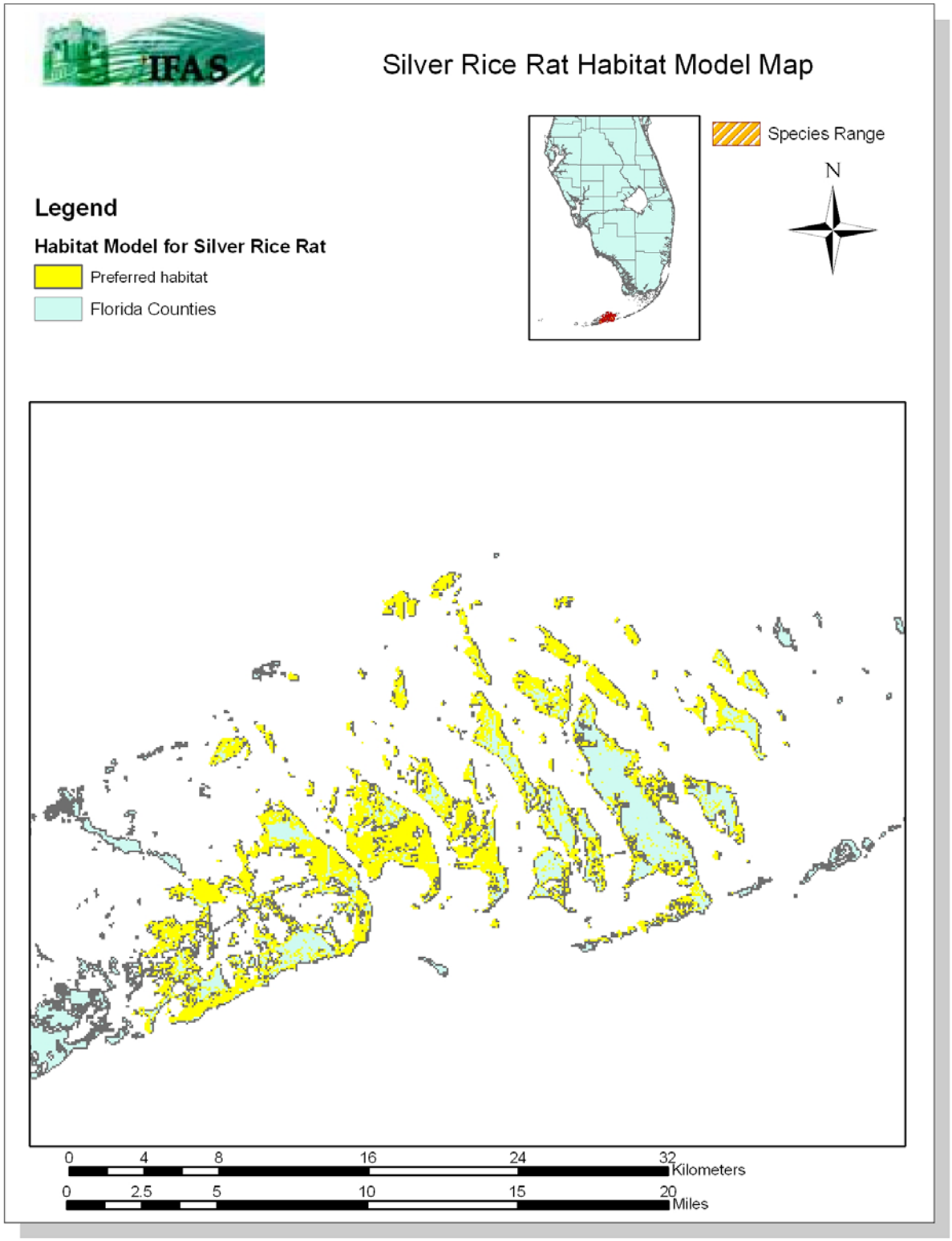

Figure 8. Modeled habitat for **Silver Rice Rat** *Oryzomys palustris natator* (syn. *Oryzomys argentatus*)

Key Largo Woodrat
Neotoma floridana smalli

Habitat references:
Prefers tropical hammock, but also will use open disturbed habitat adjacent (<= 180 m) to the hammock (Humphrey, pers. comm., 2001).
Live oak hammocks, hardwood hammocks, mixed hardwood swamps, most common from swamp forest (Layne et al. 1977).
Hydric, mesic, costal hammocks and swamps, especially ecotone between hydric and mesic communites (Pearson 1954).
Variety of habitats, but prefers low wet ground, hammocks, and swamps. Associated with ""large timber"" (Worth 1950 cited in Layne).
Prefer hardwood hammocks and swamps (Eisenberg 1988).
Mature, undisturbed subtropical hardwood (hammock) forest. Optimal habitat: dominant trees must be at least 25-30 cm in diameter; rat abundance increases with hammock maturity (Layne 1977).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992. The species range in Humphrey (1992) is limited to the portion of Key Largo north of US1, however the range map was modified to include all of Key Largo (Figure 9).

2. Within the range of Key Largo Woodrat, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
2-Tropical Hardwood Hammock Formation
3-Semi-deciduous Tropical/Subtropical Swamp Forest

FL GAP land cover classes modeled as **suitable habitat** are:
33-Coastal Strand

FL GAP land cover classes modeled as **adjacent habitat** are:
1-Open Water
62-Urban (within 90m of preferred or suitable habitat)
63-Urban Residential (within 90m of preferred or suitable habitat)
64- Urban Open/Others (within 90m of preferred or suitable habitat)

3. No minimum critical area was modeled for the Key Largo Woodrat (Figure 9).

Additional Notes:
Figure 10 illustrates the difference in mapping Key Largo Woodrat habitat with and without urban classes.

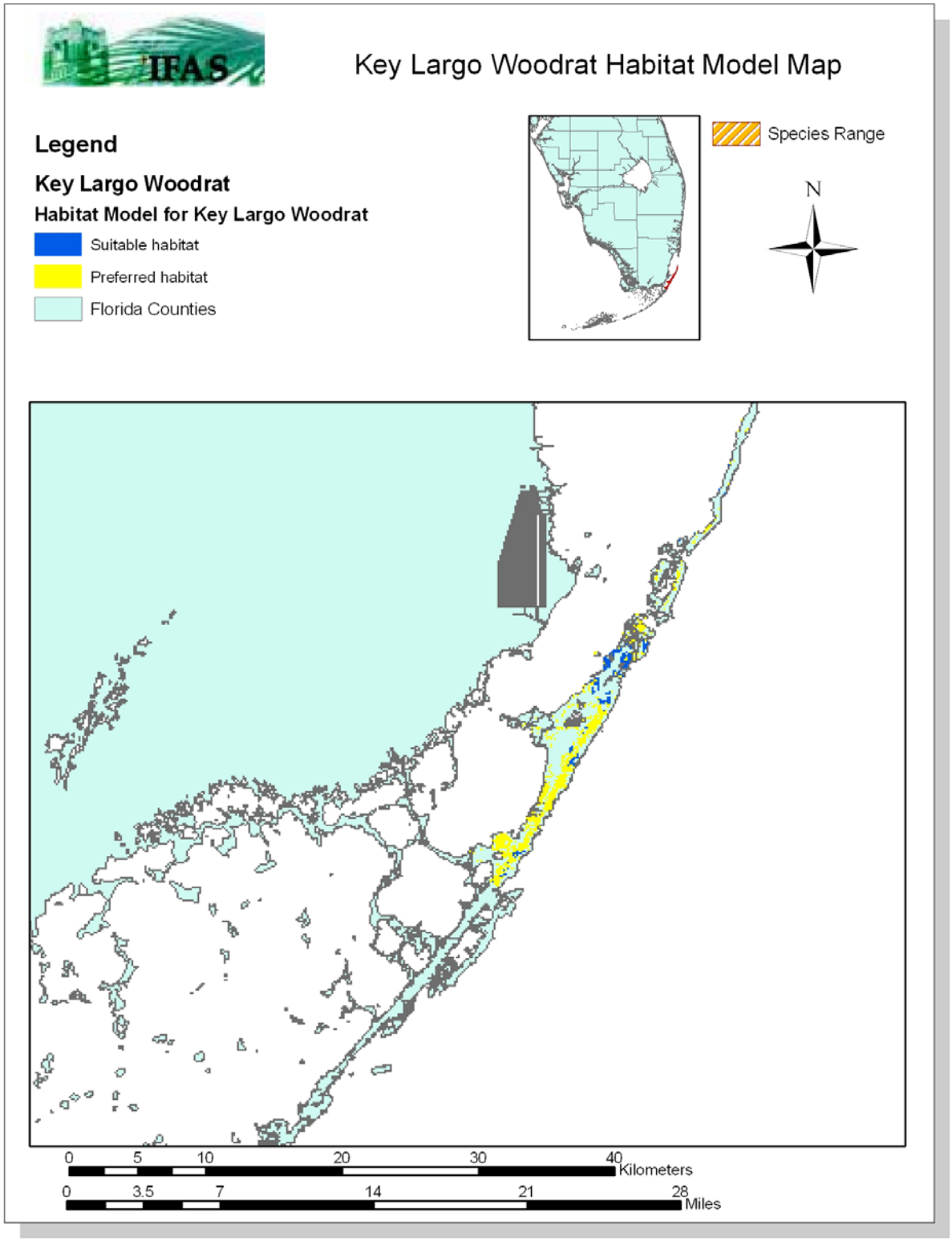

Figure 9. Modeled habitat for Key Largo Woodrat, *Neotoma floridana smalli*

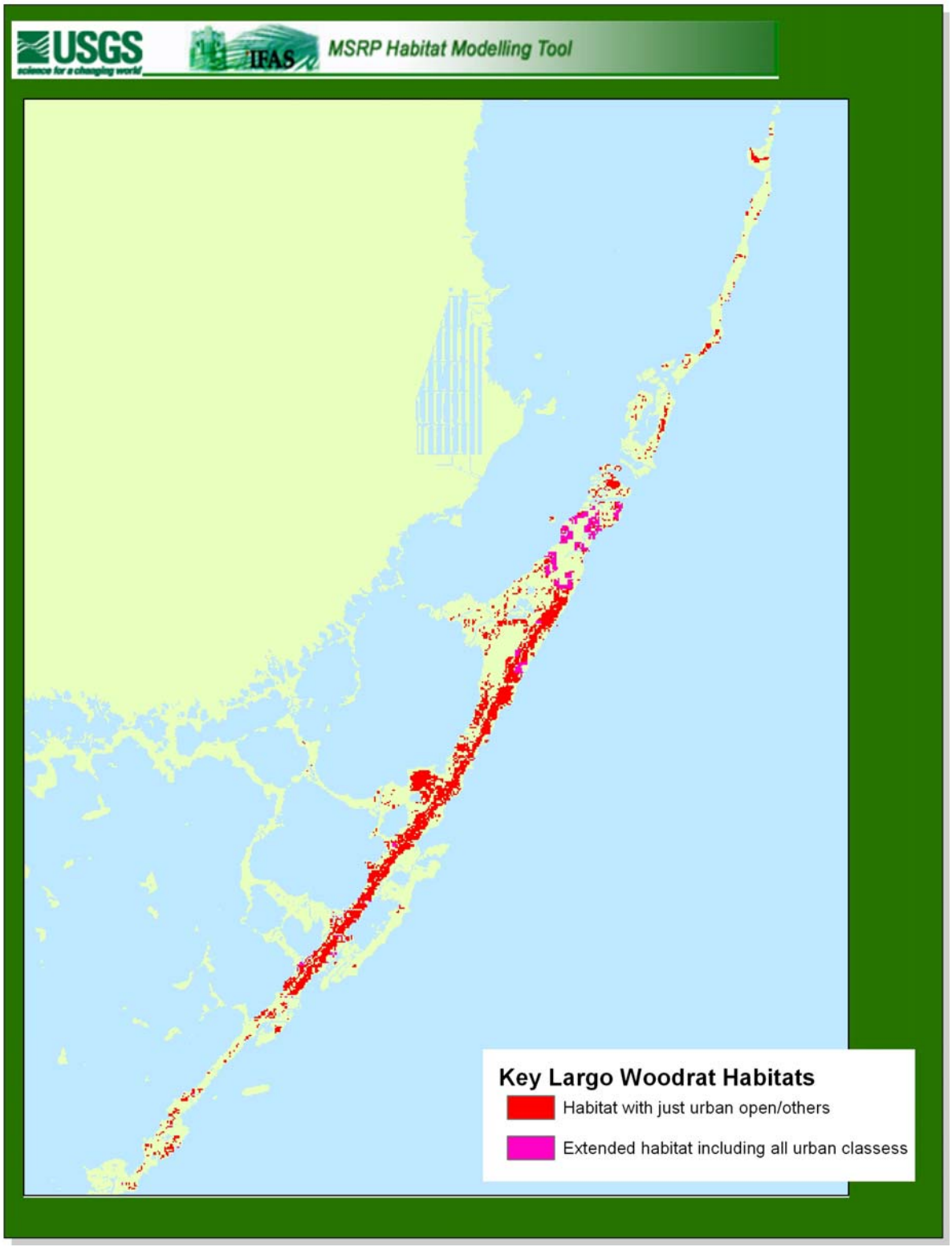

Figure 10. Key Largo Woodrat habitat with and without the inclusion of urban classes.

Birds

Audubon Crested Caracara
Polyborus plancus audubonii

Habitat references:
Prairie and savanna - natural areas and cultivated fields (Hammel 1992).
Dry prairie with intermittent marshes. Usually nests in cabbage palm. Improved pastures (Layne et al. 1977).
Dry prairies dotted with cabbage palm hammocks and low, marshy areas, as well as pastures and open woodlands (Stevenson and Anderson 1994).
Open country - dry prairies with scattered cabbage palm and wetter ares, but also in improved pastures and "relatively wooded areas with more limited stretches of open grassland" (Kale 1978).
Compared to random areas and available habitat in the overall study area, caracara home ranges had higher proportions of improved pasture and lower proportions of forest, woodland, oak scrub, and marsh. Improved pasture occurred in home ranges significantly more than all other habitats, and forest and woodland habitats occurred in home ranges significantly less than all other habitats except marsh (Morrison and Humphrey 2001).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992) (Figure 11).

2. Within the range of the Crested Caracara, land cover types were identified as preferred, suitable, or adjacent habitat. Those land covers are:

FL GAP land cover classes modeled as **preferred habitat** are:
29-Dry Prairie (Xeric-Mesic) Ecological Complex
39-Graminiod Dry Prairie Ecological Complex
66-Pasture/Grassland/Agriculture

FL GAP land cover classes modeled as **suitable habitat** are:
41-Wiregrass Grassland
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group54-Temperate Wet Prairie
54- Temperate Wet Prairie
55-Maidencane Marsh

FL GAP land cover classes modeled as **adjacent habitat** are:
24-Live Oak Woodland
25-South Florida Slash Pine Woodland
35-Xeric Scrubland

36-St. Johns Wort Shrubland Compositional Group

3. No minimum critical area was modeled for the Crested Caracara (Figure 11).

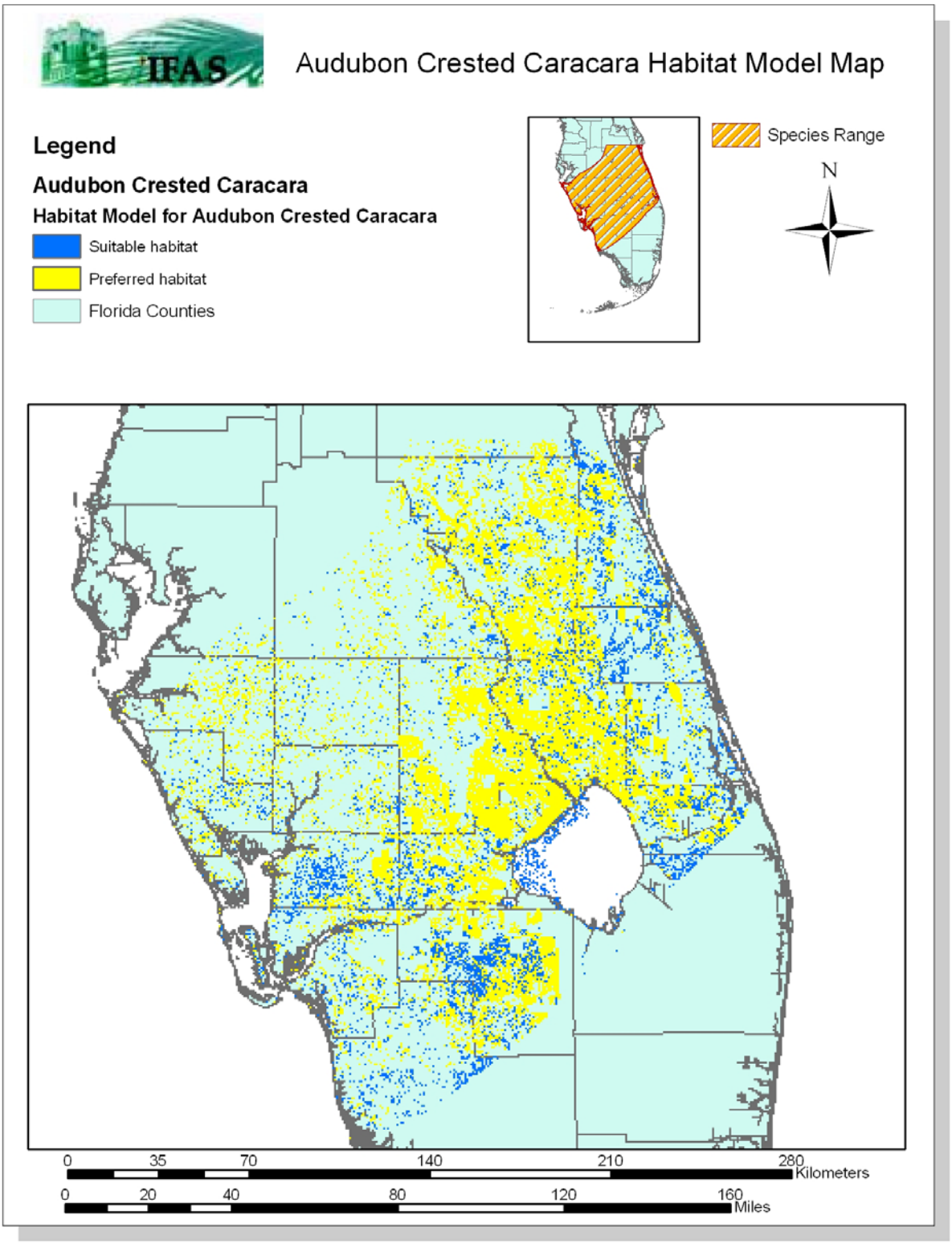

Figure 11. Modeled habitat for Audubon Crested Caracara**,** *Polyborus plancus audubonii*

Bald Eagle
Haliaeetus leucocephalus

Habitat references:
At the macro scale, nest typically occur in mature forests, usually less than 2km from water with suitable foraging opportunities. Actual distance to water will vary and may not be as critical as the quality of the foraging area that is present (Buehler 2000).
Nests largely in living pines. Consider primary habitat around nests 750 ft buffer, secondary habitat buffer zone is 1500 ft. Average nest distance to water is 576 m in north Florida and 1.48 km in central Florida. Most nests are within 3 km of open water greater than 10 ha in size (Collopy 1987).
Forage near water - estuaries, lakes, open marshes, and shorelines - salt and fresh (Hammel 1992).
Usually found near water. Nesting 61% in pine, 14% in cypress, and 23% in mangrove (Layne et al. 1977).
Occurs on coast or around large inland lakes or rivers (Stevenson and Anderson 1994).
Most nest in live or dead pine trees throuout Florida (Collopy 1987).
In North Carolina, nonbreeding bald eagles used large loblolly pines and trees with leafless crowns in areas that were less dense, had less canopy cover, were closer to forest edges, and had larger trees than randomly selected areas (Chester et al 1990).
Use live oak trees on Kanapaha Prairie, Alachua Co. (Folk 1992).
Nesting near large bodies of water, and feeding along shore or over extensive shallow water. Some interior eagles nest on tree islands in large marshes, or mainly dry prairies with small marshes and ponds. Nesting in pine or cypress over much of the state, mangroves along the southwest coast (Kale 1978).

1. The species ranges throughout South Florida (Rodgers et al., 1996) (Figure 12).

2. Within the Bald Eagle's range, all forest/nesting habitat was identified and all marsh/forage habitat greater than 10 ha was identified.

FL GAP land cover classes modeled as **forest/nesting habitat** are (**preferred habitat** is **bold**):
2-Tropical Hardwood Hammock Formation
3-Semi-deciduous Tropical/Subtropical Swamp Forest
4-Xeric-Mesic Live Oak Ecological Complex
5-Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex
6-Bay/Gum/Cypress Ecological Complex
7-Loblolly Bay Forest
9- Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
12-Casuarina Forest
13-South Florida Slash Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex

16-Mesic-Hydric Pine Forest Compositional Group
17 -Swamp Forest Ecological Complex
18-Cypress Forest Compositional Group
19-Mixed Evergreen.Cold-deciduous Hardwood Forest
24-Live Oak Woodland
25-South Florida Slash Pine Woodland
27-Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest

FL GAP land cover classes modeled as **marsh/forage habitat** are:
1-Open water
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group
47-Salt Marsh Ecological Complex
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh
56-Forb Emergent Marsh
57-Water Lily or Floating Leaved Vegetation
66-Pasture/Grassland/Agriculture

3. Exclude forest that is greater than 200m from edge of the forest land cover type.

4. Exclude marsh that is greater than 200m from edge of the marsh land cover type.

5. Exclude forest that is greater than 3 km from marsh.

6. Exclude marsh that is greater than 3 km from forest (Figure 12).

Additional Notes:
Existing eagle nest site location data should be plotted and compared with the model results.

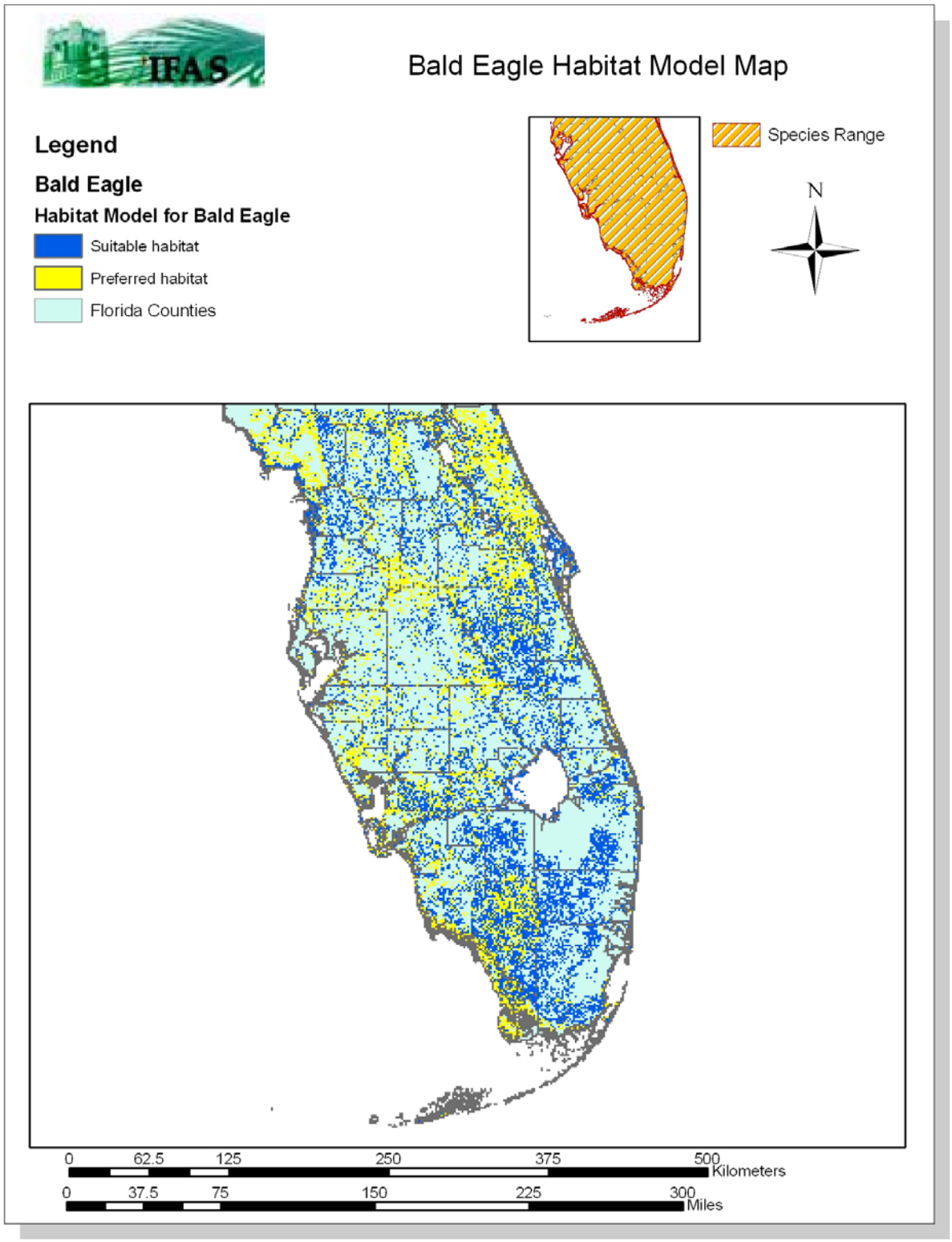

Figure 12. Modeled habitat for Bald Eagle, *Haliaeetus leucocephalus*

Florida Scrub Jay
Aphelocoma coerulescens

Habitat references:
Several types of scrub communities IF scrub oaks occur, will utilize adjacent non-scrub habitat. Especially interior and Atlantic Coast sand ridges, xeric oak scrub, open sand pine scrub, open scrubby flatwoods, rosemary scrub, and scrubby coastal strand. Periodically burned, low growing {approximately 1-3 m} oak scrub with abundant bare sand {>10%}, and only scattered tall pines, if any. Dependent on habitat, density 2-6 pairs per 40 ha with an average of 5 pairs per 40 ha in good habitat. Mean territory size for good habitat is 9 ha with a range of 4-18 ha (Fitzpatrick et al. 1991).
Thick scrub with scrub oaks and sand pine scrub (Hammel 1992).
Sand pine scrub and scrubby flatwoods (Layne et al. 1977).
Open scrub habitats along ridges that are ancient sand dunes, with greater than 50% tree canopy. In scrub, associated with Quercus inopina, Q. myrtifolia, Q.geminata, Q. chapmanii, saw palmetto, Sabal etonia, sand pine, and Ceratiola ericoides. Found in Atlantic Coastal Ridge along Florida's east coast, Lake Wales Ridge, and Ocala in north Florida. In winter, acorns are important, also bird feeders (Stevenson and Anderson 1994).
Scrub jay density on Kennedy Space Center was highest where scrub-oak cover was 60% or more, open space exceeded 10%, pine cover was less than 20%, and forests were more than 136 m away. Suitable habitat includes landscapes not excessively drained or dominated by preferred habitat. Open oak occurs as patches in a matrix (Breininger 1995).
Oak scrub of live oak, myrtle oak, chapman oak with saw palmetto, sand palmetto, scattered sand pine, and rosemary. Avoids wet habitats and forests (Kale 1978).

1. The species ranges throughout the Everglades region and north through the lake region along the center of the state (Rodgers et al., 1996). (Figure 13).

2. Within the range of the Florida Scrub Jay, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
35-Xeric Scrubland

FL GAP land cover classes modeled as **suitable habitat** are:
26-Sandhill Ecological Complex

FL GAP land cover classes modeled as **adjacent habitat (within 1000 m of suitable or preferred habitat)** are:
4-Xeric-Mesic Live Oak Ecological Complex
13-South Florida Slash Pine Forest
14-Sand Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex

24-Live Oak Woodland
25-South Florida Slash Pine Woodland
29-Dry Prairie (Xeric-Mesic) Ecological Complex
34-Groundsel-tree/Marsh Elder Tidal Shrubland
36-St. Johns Wort Shrubland Compositional Group
39-Graminiod Dry Prairie Ecological Complex
41-Wiregrass Grassland
70-Recreation

3. Florida Scrub Jay was modeled with a MCA of 2ha (Figure 13).

Additional Notes:
Existing Scrub Jay location data should be plotted and compared to model results.

Figure 14 shows the impact of including adjacent habitat with different dispersal assumptions.

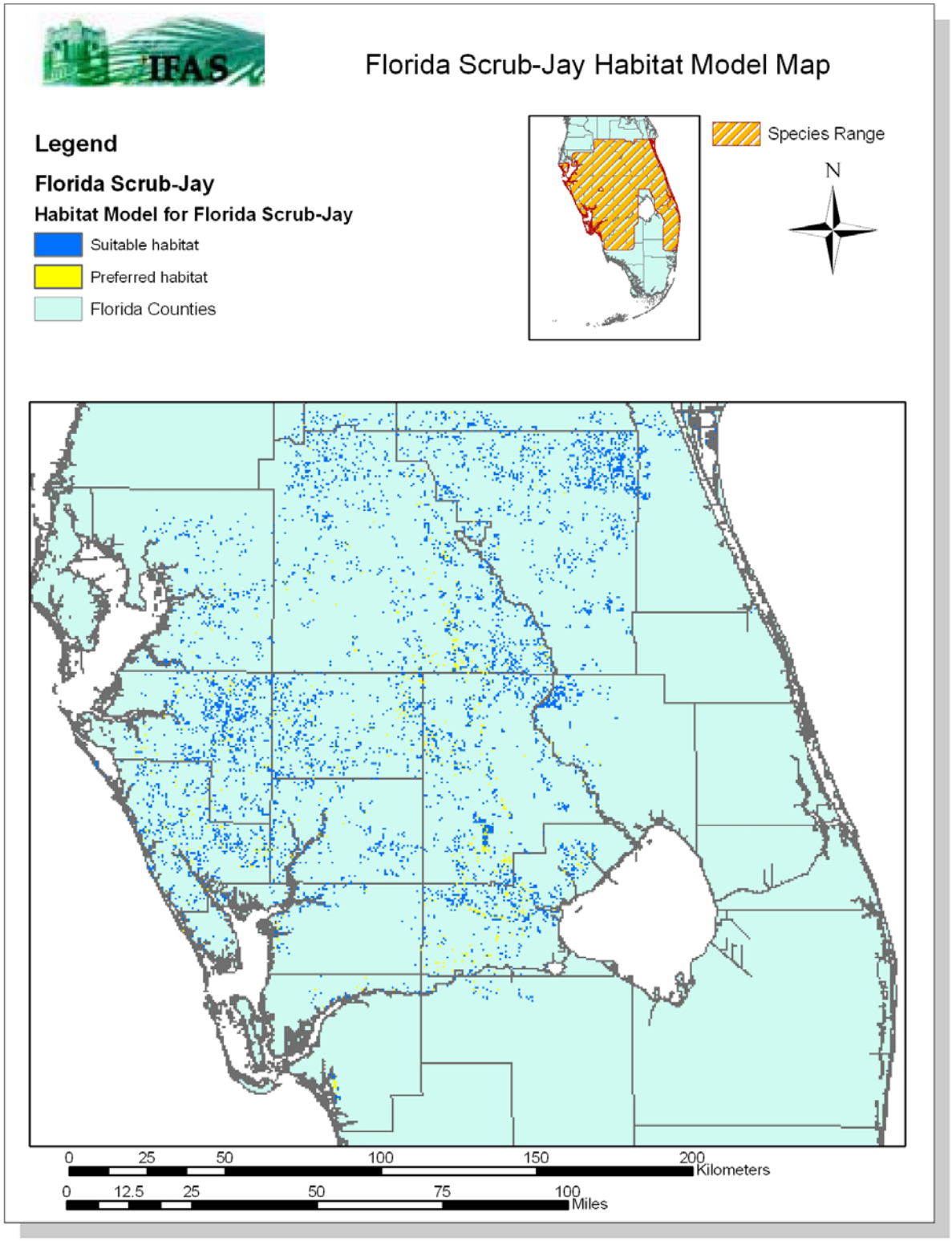

Figure 13. Modeled habitat for Florida Scrub Jay, *Aphelocoma coerulescens*

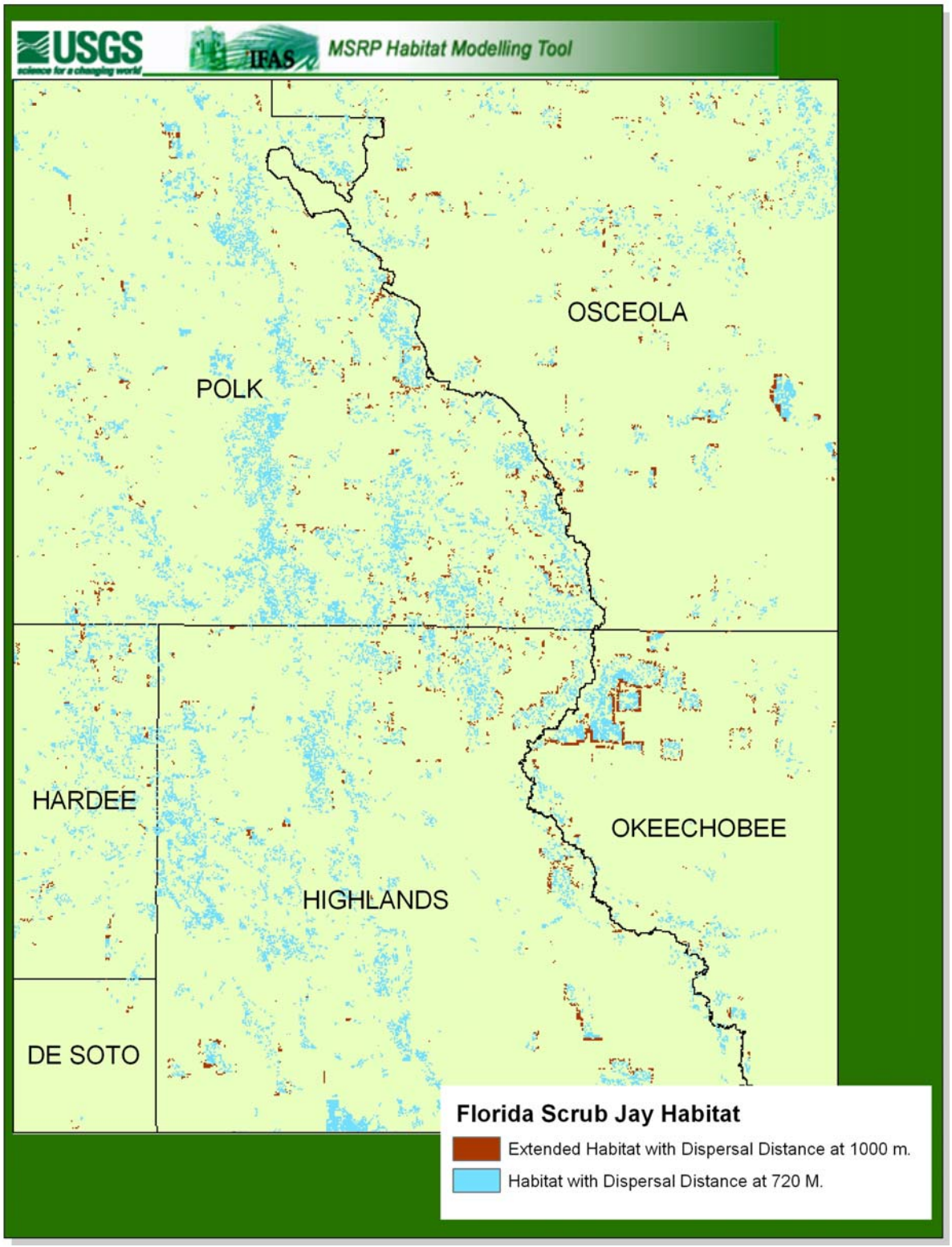

Figure 14. Changes in habitat for the Florida Scrub Jay under two dispersal distances, 720, and 1000m.

Everglades Snail Kite
Rostrhamus sociabilis plumbeus

Habitat references:
Wetlands with snails. Disperse from south Florida in drought. During drought, habitat use changes to canals, flooded fields, borrow pits, lakes, and small temperary or permanent wetland patches, although not normally used, these habitats important during droughts. As far north as Jacksonville during drought-induced dispersal. Drought habitats may be used 2 out of every 6 years, important locations are the Kissimmee chain of lakes area and lower half of the east coast (Takekawa and Beissinger 1989).
Extensive freshwater marshes, especially where shrubs and small trees are present in addition to open water and where apple snails are present (Hammel 1992).
Breeding restricted to some impoundments on St Johns River, Lake Okeechobee, parts of Conservation area 1, 2A, 2B, 3A, 3B, and north Everglades National Park. Freshwater marshes with extensive shallow areas {<4'} of permanent water and shrubs, or small trees for perching (Layne et al. 1977).
Expansive freshwater marshes of cattails and sawgrass, with extensive open water dotted with shrubs and saplings for perching and nesting (Stevenson and Anderson 1994).
Freshwater marshes with distant horizon and low vegetation. Shallow waters (<4 feet) in sloughs, Eleocharis flats that contain water throughout the year dispersed in sawgrass or cattail marsh with scattered shrubs, small trees, for perching, and nesting (Kale 1978).

1. The species ranges throughout the Everglades region and north through the lake region along the center of the state (Rodgers et al., 1996). (Figure 15).

2. Since the snail kite responds dynamically to changing forage and nesting conditions in selecting habitat (Bennetts and Kitchens, 2000), the model broadly identifies the majority of the wetlands in south Florida as potential habitat.

3. Within the range of Snail Kite, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh

FL GAP land cover classes modeled as **adjacent habitat** are:

1-Open water
56-Forb Emergent Marsh
57-Water Lily or Floating Leaved Vegetation

3. No minimum critical area was modeled for the Snail Kite (Figure 15).

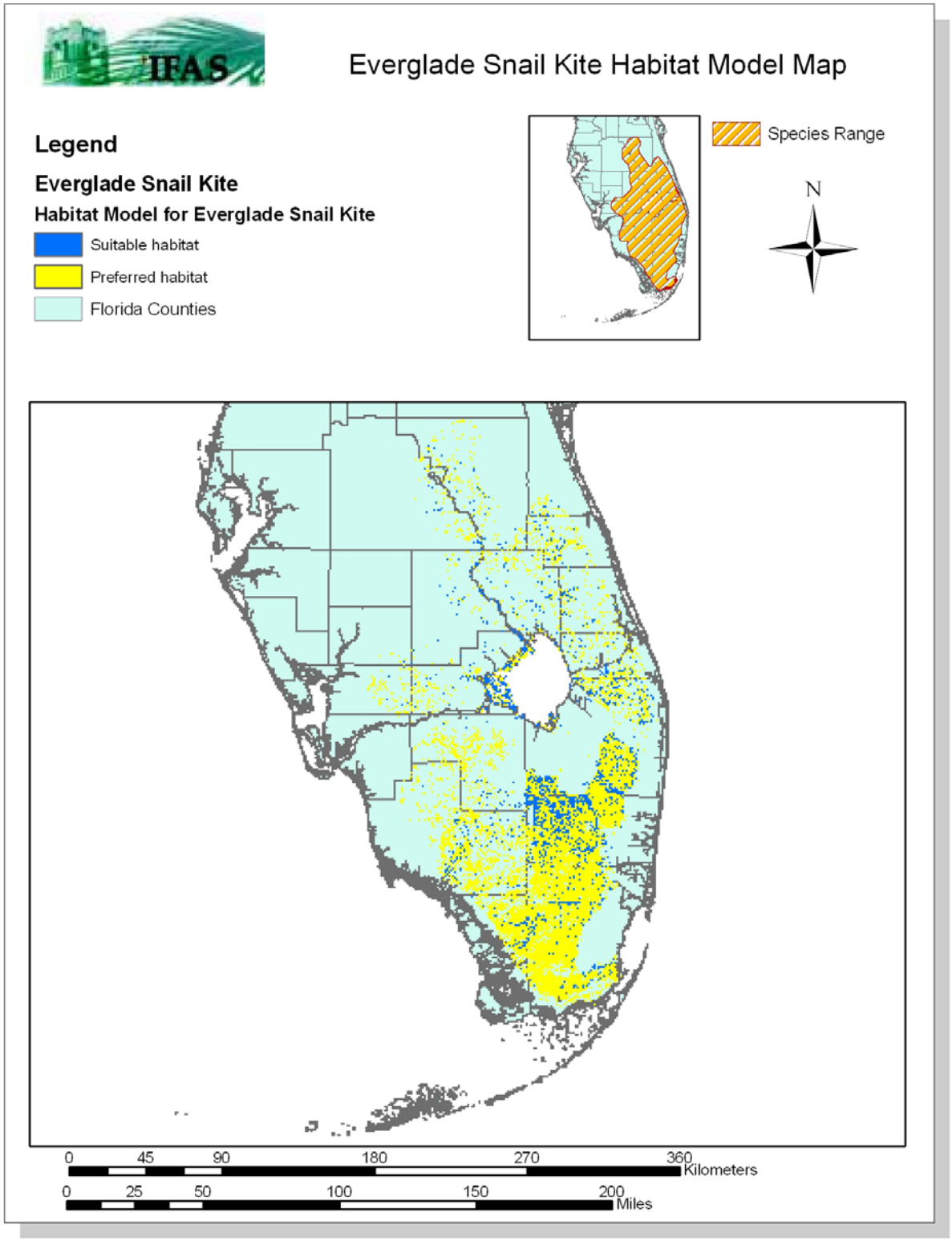

Figure 15. Modeled Habitat for Everglades Snail Kite**,** *Rostrhamus sociabilis plumbeus*

Piping Plover
Charadrius melodus

Habitat references:
Winter resident along Gulf and Atlantic coasts. Outer beaches, extensive sand fills, and large tidal flats (Layne et al. 1977).
Beaches, mudflats, and sandflats along Gulf and Atlantic coasts. Barrier island beaches and spoil islands on Gulf (Haig 1992 NAB).
Sandy beaches and mud flats (Stevenson and Anderson 1994).
Outer sand beaches, extensive sand fills, large tidal sand flats, and mud flats (Kale 1978).

1. The species ranges throughout South Florida along the coast (Rodgers et al., 1996). (Figure 16).

2. Within the range of the Piping Plover, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
59-Sand, Beach

3. No minimum critical area was modeled for the Snail Kite (Figure 16).

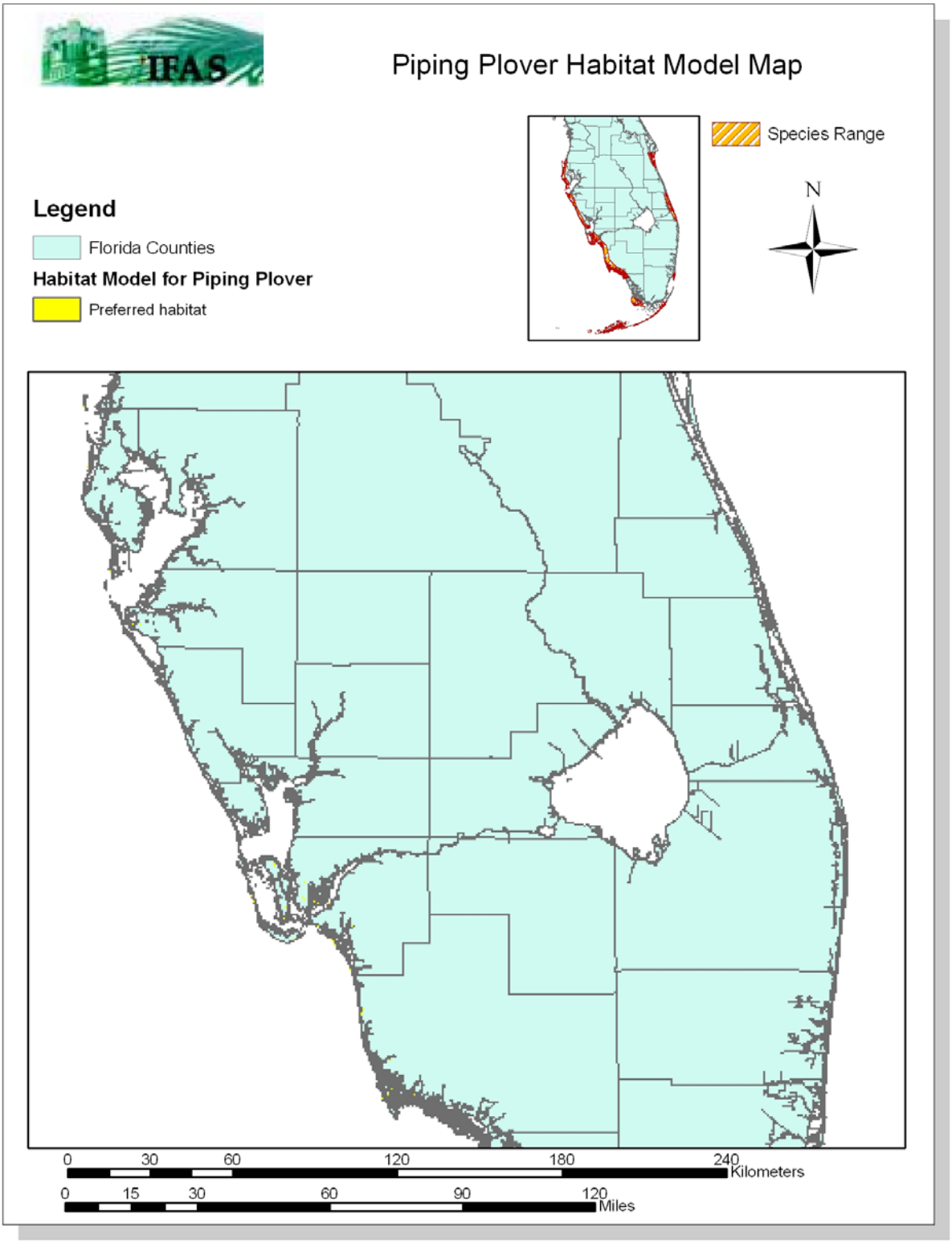

Figure 16. Modeled habitat for Piping Plover, *Charadrius melodus*

Cape Sable Seaside Sparrow
Ammodramus maritimus mirabilis

Habitat references:
Dispersal distance is 1.2 km (13 cells), with a minimum critical area of 10 hectares (Kushlan, 1982).

Prefers muhly grass, black needle rush, and saltmarsh cordgrass marsh communities (Kushlan, 1982).
Wintering in moist grassy areas in open pinewoods, broomsedge and other moist fields (Hammel 1992).
Broomsedge fields and wet meadows (Layne et al. 1977).
Low, moist areas in weedy fields and along roadsides, and in open pine flatwoods with Aristida stricta as the dominant ground cover (Stevenson and Anderson 1994).
Wintering in moist grassy areas in open pinewoods, broomsedge and other moist fields (Hammel 1992).
Broomsedge fields and wet meadows (Layne et al. 1977).
Low, moist areas in weedy fields and along roadsides, and in open pine flatwoods with Aristida stricta as the dominant ground cover (Stevenson and Anderson 1994).

1. At the time of its discovery the species range was thought to be limited to the southwest region of the Everglades in proximity to Cape Sable (Rodgers et al., 1996). Today the Cape Sable subspecies in considered to be limited to the southern tip of Florida (Miami-Dade, Collier, and Monroe counties), south of Tamiami Trail and on the east and west sides of Shark River Slough (Post and Greenlaw, 2000) (Figure 17).

2. Within the range of the Cape Sable Seaside Sparrow, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
45-Muhly Grass Marsh

FL GAP land cover classes modeled as **suitable habitat** are:
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh

3. Cape Sable Seaside Sparrow was modeled with a MCA of 10ha (Figure 17).

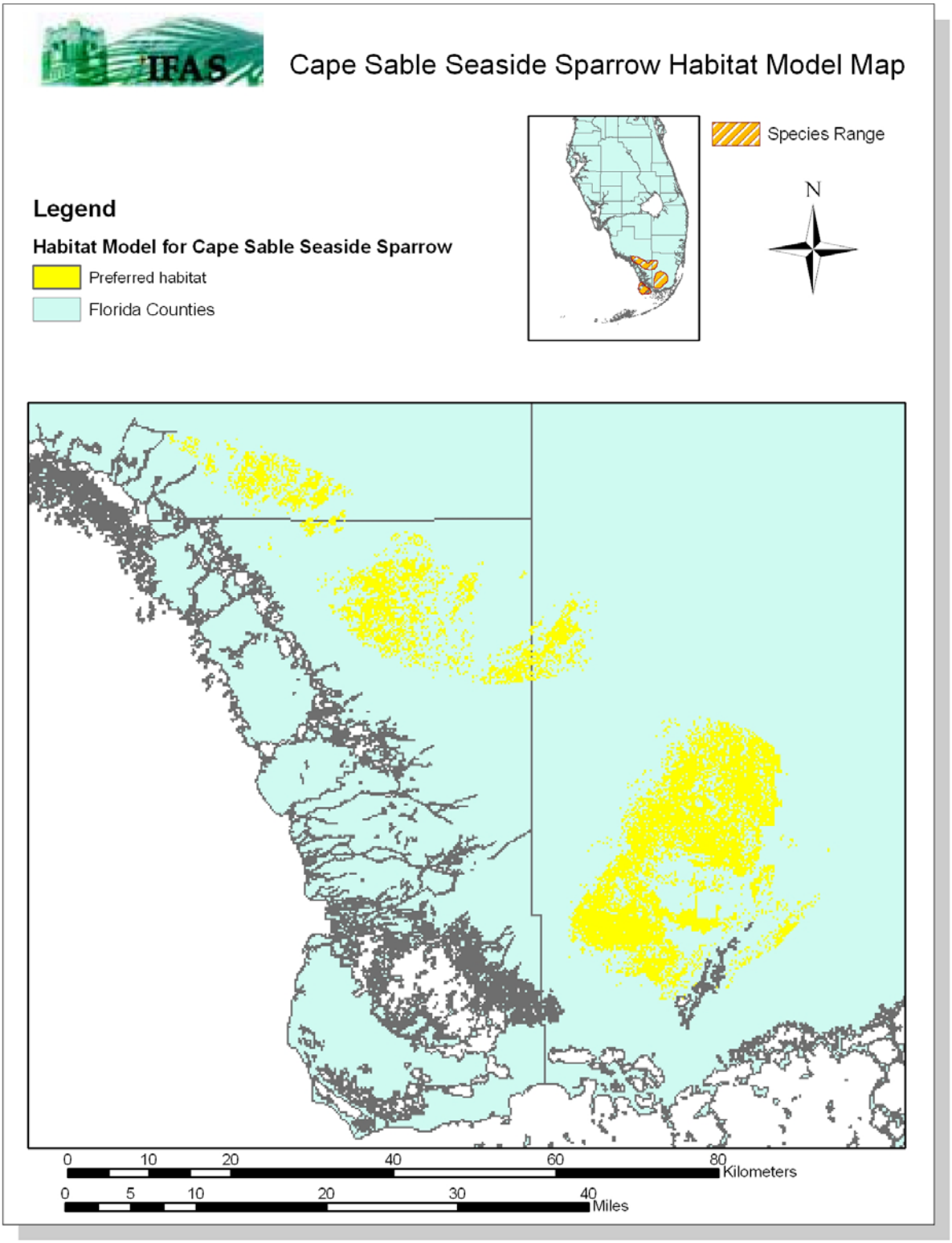

Figure 17. Modeled habitat for Cape Sable Seaside Sparrow, *Ammodramus maritimus mirabilis*

Florida Grasshopper Sparrow
Ammodramus savannarum floridanus

Habitat references:
Southcentral prairies, palmetto prairies, and pastures. Avoids even widely scattered pines {<1 tree/ha}. Associated only with dry prairie with low sparse {<10% cover} growth of palmetto and shrubs and greater than 20% bare ground. Longest observed movement was 2 km. Male home ranges during breeding season have little overlap, usually separated by greater than 30 m, and greater than 75 m from plantation or cypress domes. Mean home range is 1.77 ha, with a range of 0.51 - 4.82 ha. Density is approximately 0.06 territories per ha (Delany et al. 1992).
Wintering populations found in broomsedge fields, especially grassy areas, old fields, and open pinewoods (Hammel 1992).
Widespread in Florida in winter. Old fields and hay fields. Avoids wet meadows, but prefers dry tallgrass habitats (Layne et al. 1977).
Pine forests and grasslands prairies with short hydroperiod (Robertson and Kushlan 1984).
It selects habitats from dry prairie grasslands with sparse undergrowth of dwarf live oak and saw palmetto to incompletely managed pasturelands, frequently burned and with variable amounts of saw palmetto. When other races reach Florida in winter, they inhabit woodland edges, weedy areas, and cultivated fields with varying amounts of scrub growth (Stevenson and Anderson 1994).
Require open areas (22-36% bare ground) for foraging, but enough vegetation for nesting cover. Nests usually are shielded by a shrubby growth of Serenoa repens (Delany and Linda 1994).
Found in cattle pastures and structurally simple, early successional vegetation. Densities are lower in areas not burned within 2.5 years. Also in mechanically cleared pastures (Delany and Cox 1986).
Prefers stunted oaks and saw palmettos, but may be able to persist in some managed cattle pastures (Delany et al 1985).
May occur in cattle pastures with or without dwarf palmetto (Kale 1978).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992) (Figure 18).

2. Within the range of the Florida Grasshopper Sparrow, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
29-Dry Prairie (Xeric-Mesic) Ecological Complex
38-Saltwort/ Glaswort Ecological Complex
41-Wiregrass Grassland

FL GAP land cover classes modeled as **suitable habitat** are:
42-Graminoid Emergent Marsh Compositional Group
66- Pasture/Grassland/Agriculture

FL GAP land cover classes modeled as **adjacent habitat** are:
36-St. Johns Wort Shrubland Compositional Group
52-Sparsely Wooded Wet Prairie Compositional Group
54-Temperate Wet Prairie

3. Contiguous areas of habitat less than 44 hectares were removed because they were considered less than the minimum critical area necessary to support 25 pair of birds (Delany, pers. comm., 2001) (Figure 18).

Additional Notes:
Improved pasture is not habitat for the Grasshopper Sparrow. Water Management District land covers or county tax records may help separate FL GAP class 66 into improved and unimproved pasture to better define their habitat.

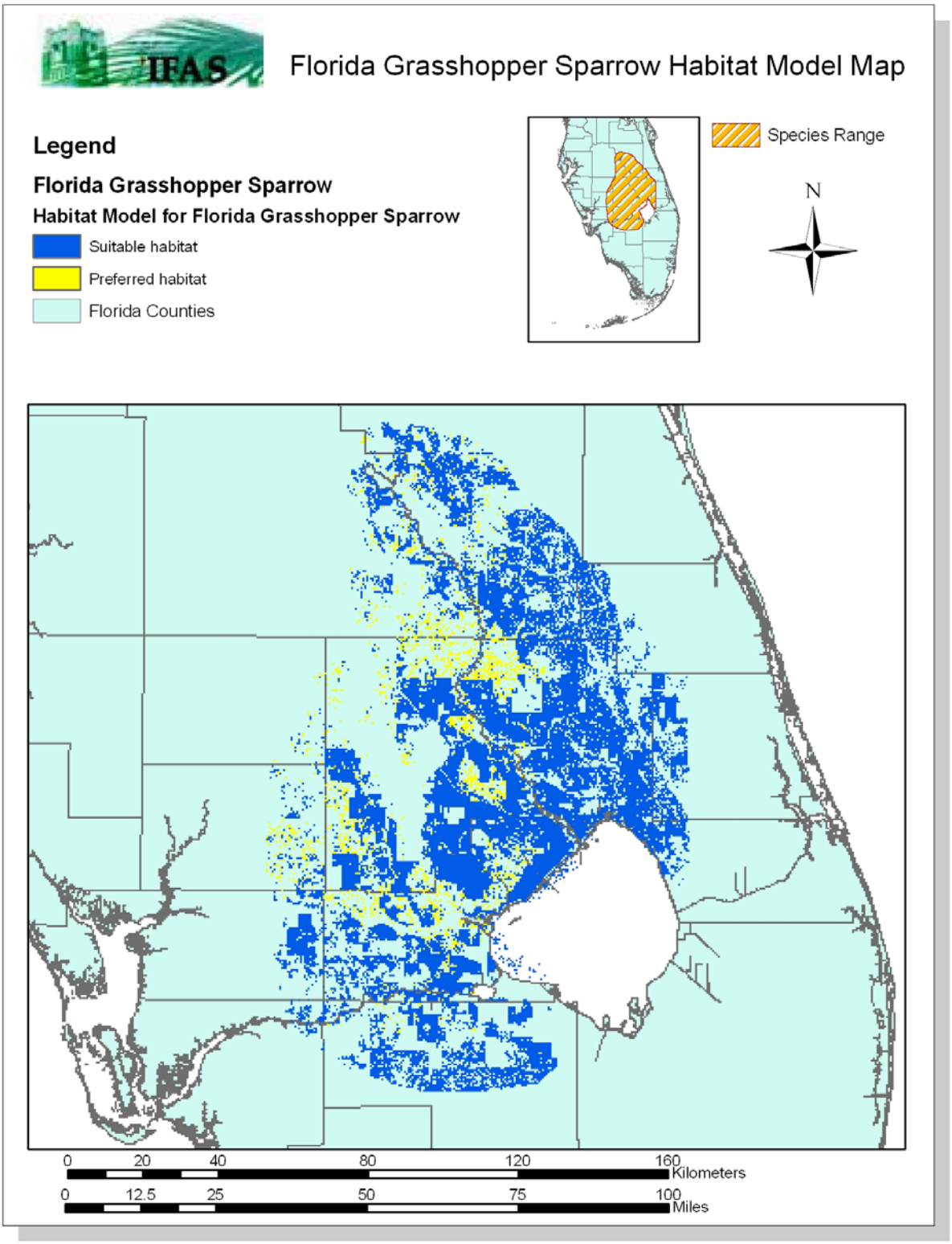

Figure 18. Modeled habitat for Florida Grasshopper Sparrow**,** *Ammodramus savannarum floridanus*

Wood Stork
Mycteria americana

Habitat references:
Nesting in swamps and tall trees along lakeshores. Forages in all salinity ranges including swamps, lakeshores, streams, estuaries, and mudflats (Hamel 1992).
Fresh and brackish wetlands, marshes, flooded pastures, and ditches for foraging. Nests over standing water or on islands (Layne et al. 1977).
Interior wetlands, coastal and estuarine wetlands (Robertson and Kushlan 1984).
Breeding in mangrove and cypress swamps to Duval/Gadsen counties (Robertson and Woolfenden 1992).
Cypress and mangrove swamps for breeding. Forages in fresh, brackish or salt water, in marshes, ponds, ditches, flooded prairies, and on mud flats usually in shallow water (Stevenson and Anderson 1994).
In Florida, the amount of pine forest cover within 25 km of nesting colonies was positively correlated with colony productivity, while the amount of freshwater marsh and barren land within 50 km both correlated negatively with colony productivity. Colonies surrounded by larger areas of cypress and hardwood swamp tended to average slightly more fledglings than colonies surrounded by larger areas of freshwater marsh, salt marsh, and shrub swamp (Cox 1991).
Freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps. Feeding in freshwater marshes, flooded pastures and ditches, and especially in depressions in marshes or swamps that keep water as water levels fall. Don't travel far over large bodies of water (Kale 1978).
Storks nesting in south Florida routinely flew 10-40 km to feeding areas and as far as 95-130 km when closer wetlands became dry (Ogden et al 1978, Browder 1984), requiring overnight roosting at or near the foraging grounds.

1. The species ranges throughout South Florida (Rodgers et al., 1996) (Figure 19).

2. The following land cover types were identified as potential habitat:

FL GAP land cover classes modeled as **preferred habitat** are:
6-Bay/Gum/Cypress Ecological Complex
11-Red Mangrove Forest
18-Cypress Forest Compositional Group
23-Red Mangrove Woodland
42-Graminoid Emergent Marsh Compositional Group
43-Sawgrass Marsh
44-Spikerush Marsh
45-Muhly Grass Marsh
46-Cattail Marsh Compositional Group
47-Salt Marsh Ecological Complex
48-Sand Cordgrass Grassland
49-Black Needle Rush Marsh

50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh
56-Forb Emergent Marsh

FL GAP land cover classes modeled as **suitable habitat** are:
3-Semi-deciduous Tropical/Subtropical Swamp Forest
7- Loblolly Bay Forest
9- Mixed Mangrove Forest Formation
10-Black Mangrove Forest
12-Casuarina Forest
17-Swamp Forest Ecological Complex
20-Buttonwood Woodland
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest
31-Brazilian Pepper Shrubland
32-Dwarf Mangrove Ecological Complex
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland

FL GAP land cover classes modeled as **suitable habitat if within dispersal distance (30 km) of preferred habitat** are:
64- Urban Open/Others
65-Agriculture
66-Pasture/Grassland/Agriculture

FL GAP land cover classes modeled as **adjacent habitat** are:
1-Open water
57-Water Lily or Floating Leaved Vegetation
58-Periphyton

3. No Minimum Critical Area is used since this species, like the snail kite, is so nomadic (Figure 19).

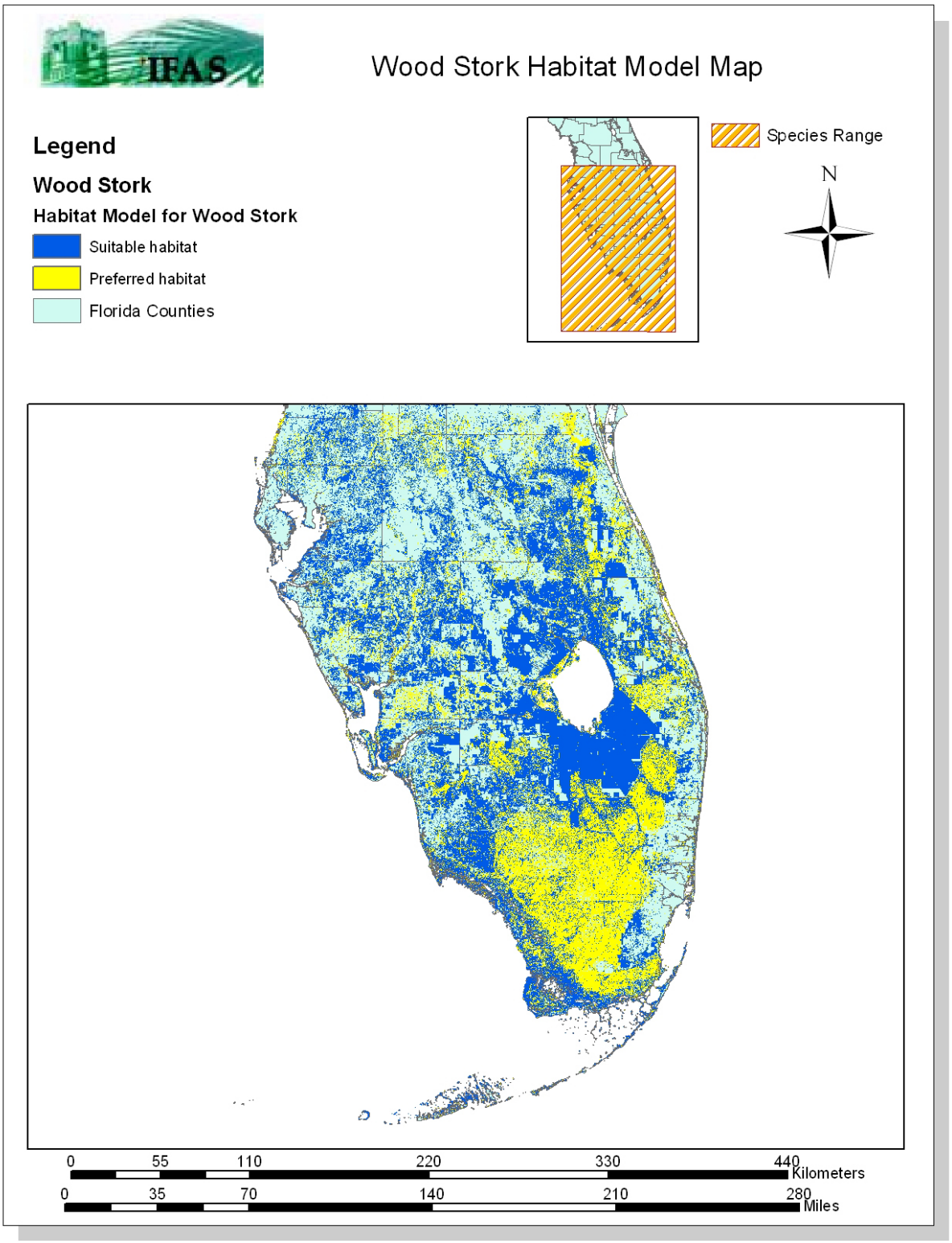

Figure 19. Modeled habitat for Wood Stork**,** *Mycteria americana*

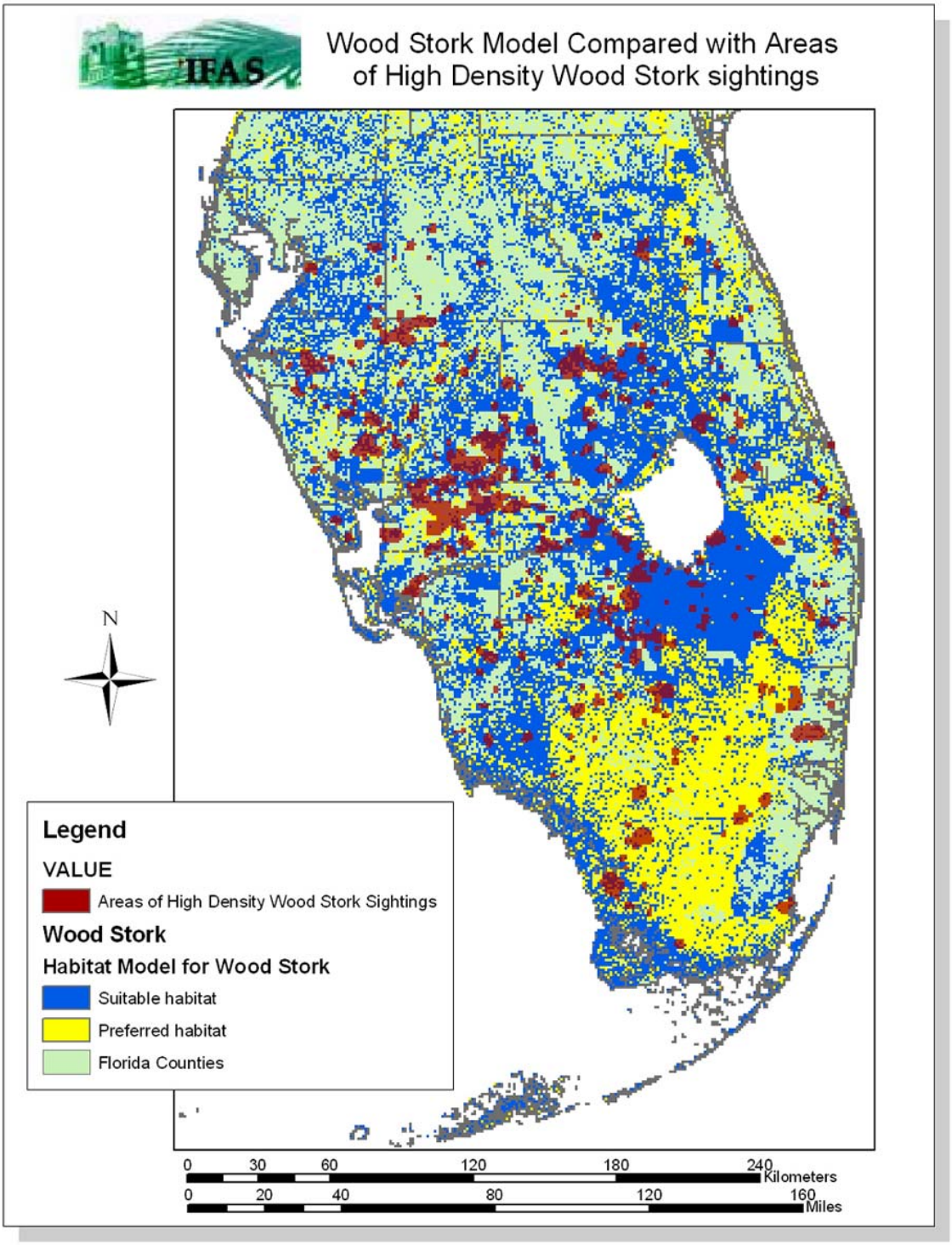

Figure 20. Areas in dark brown represent high densities of juvenile wood stork observations. May 02 - Sep 03. All of the birds are from one colony, Tamiami West (N25 45.31, W80 31.90). There are a total of 44 birds which fledged from the colony, and thus are included in this analysis (Becky Hylton, person. comm.).

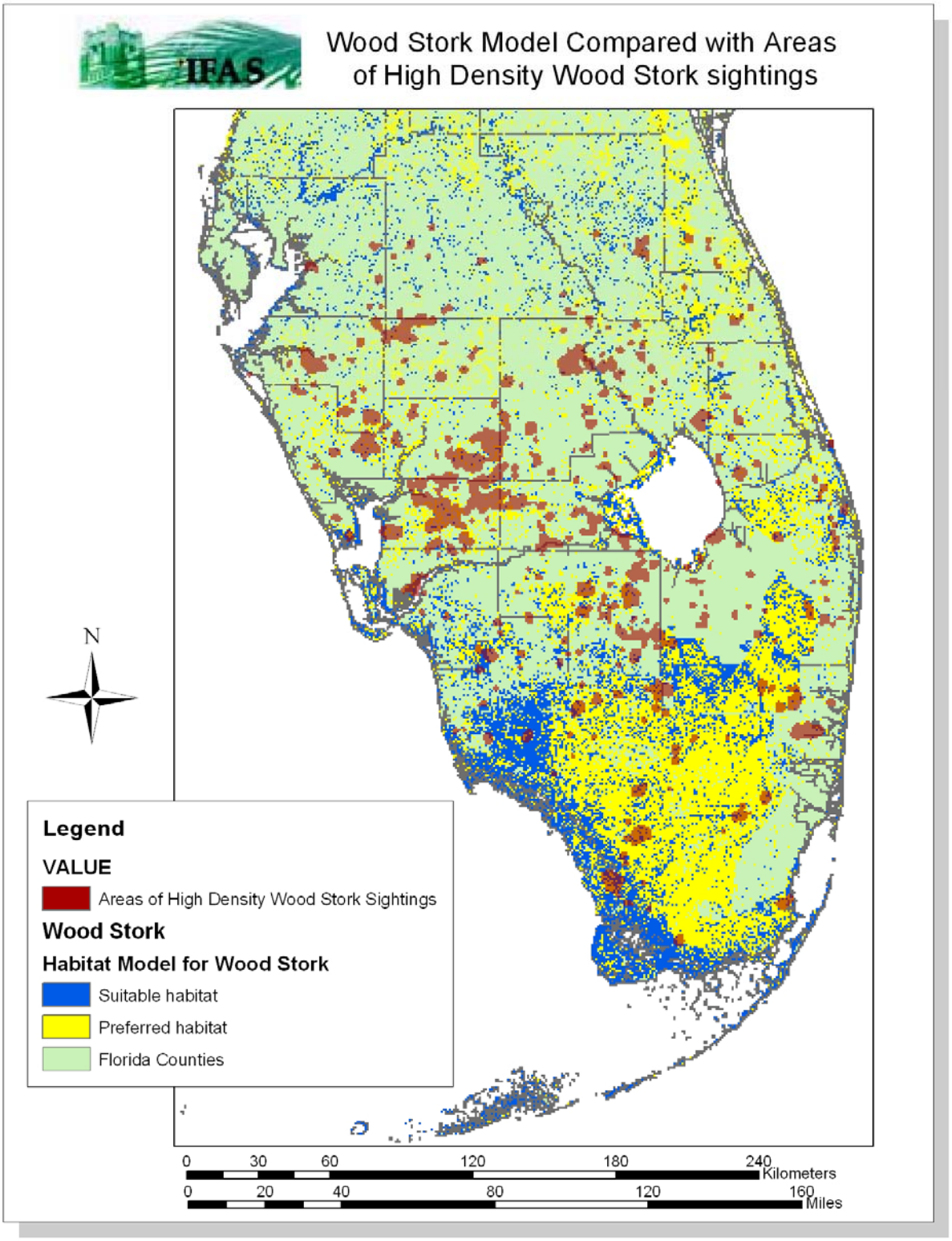

Figure 21. Modeled habitat for Wood Stork excluding agricultural classes 64-66.

Red-Cockaded Woodpecker
Picoides borealis

Habitat references:
Home range size of clans has a mean of 3.4 individuals, Appalachia north Florida, has a minimum area mean of 81 ha, harmonic mean of 129 ha. Ninety nine percent of foraging in longleaf or slash pine stands, but prefered longleaf. Stands with trees greater than 20 meters high, and greater than 20 cm dbf selected, typically old age. Avoids areas with high stem density and young age. Density approximately 1 clan per 129 ha (Porter and Labisky 1986).
Clan foraging range, south of Orlando, mean is 148 ha, comprised mostly of longleaf pine flatwoods, cypress domes also important for foraging (Delotelle et al. 1983).
In southwest Florida, the average range is 144 ha per clan. Foraging area may encompass a variety of habitat types, including wet prairie/marshes, xeric to mesic pine forest, sandhill, and scrub communities, although pine is the predominant habitat type (Nesbitt et al. 1983).
Open pinewoods, especially longleaf, but also loblolly, shortleaf, and slash with little understory (Hammel 1992).
Pine flatwoods (Layne et al. 1977).
Pine forests of Big Cypress North (Robertson and Kushlan 1984).
Extensive, mature, open pine forests with little understory maintained by fire. Occasionaly persists in younger stands or where hardwoods have encroached. Uses longleaf, slash, shortleaf , pitch, pond and Virginia pines (Jackson 1994 NAB).
In open, frequently burned, mature pine flatwoods or uplands, nesting or feeding in variety of species of pine such as loblolly, slash, shortleaf (Pinus echinata), and pond (P. serotina), and especially longleaf pine with a low understory. Regularly forages in corn fields for corn earworms, also fruits of Prunus serotina, wax myrtle, magnolia grandiflora, Toxicodendron radicans, and swamp black gum, occasionaly forages on hardwood trunks (Stevenson and Anderson 1994).
Natal philopatry exceptionally strong in males, females typically disperse. Fidelity to breeding and wintering site strong, especially among males. In North Carolina, among dispersing individuals, mean dispersal distance in fledgling females is 4.7 km, adult females are 1.8 km, fledgling males 5.4 km, and adult males 1.8 km (Jackson 1994 NAB).
In South Carolina, total observed range was 86.9 ha. South Dakota is 44.2 ha. Year round home range average 70.3 ha, South Dakota, 35.7 ha. (Hooper et al. 1982).
Mature pine forests, especially without thick understory, especially longleaf, but also loblolly, shortleaf, slash, and pond pines (Kale 1978).

1. The species ranges throughout South Florida excluding portions of Dade and Broward counties south and east of Lake Okechobee (Rodgers et al., 1996) (Figure 22).

2. The following land cover types were identified as potential habitat:

FL GAP land cover classes modeled as preferred habitat are:
13-South Florida Slash Pine Forest
16-Mesic-Hydric Pine Forest Compositional Group
25- South Florida Slash Pine Woodland

26-Sandhill Ecological Complex

FL GAP land cover classes modeled as suitable habitat are:
3-Semi-deciduous Tropical/Subtropical Swamp Forest
4-Xeric-Mesic Live Oak Ecological Complex
14-Sand Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex
17-Swamp Forest Ecological Complex
18-Cypress Forest Compositional Group

3. Cape Sable Seaside Sparrow was modeled with a MCA of 400ha (Figure 22).

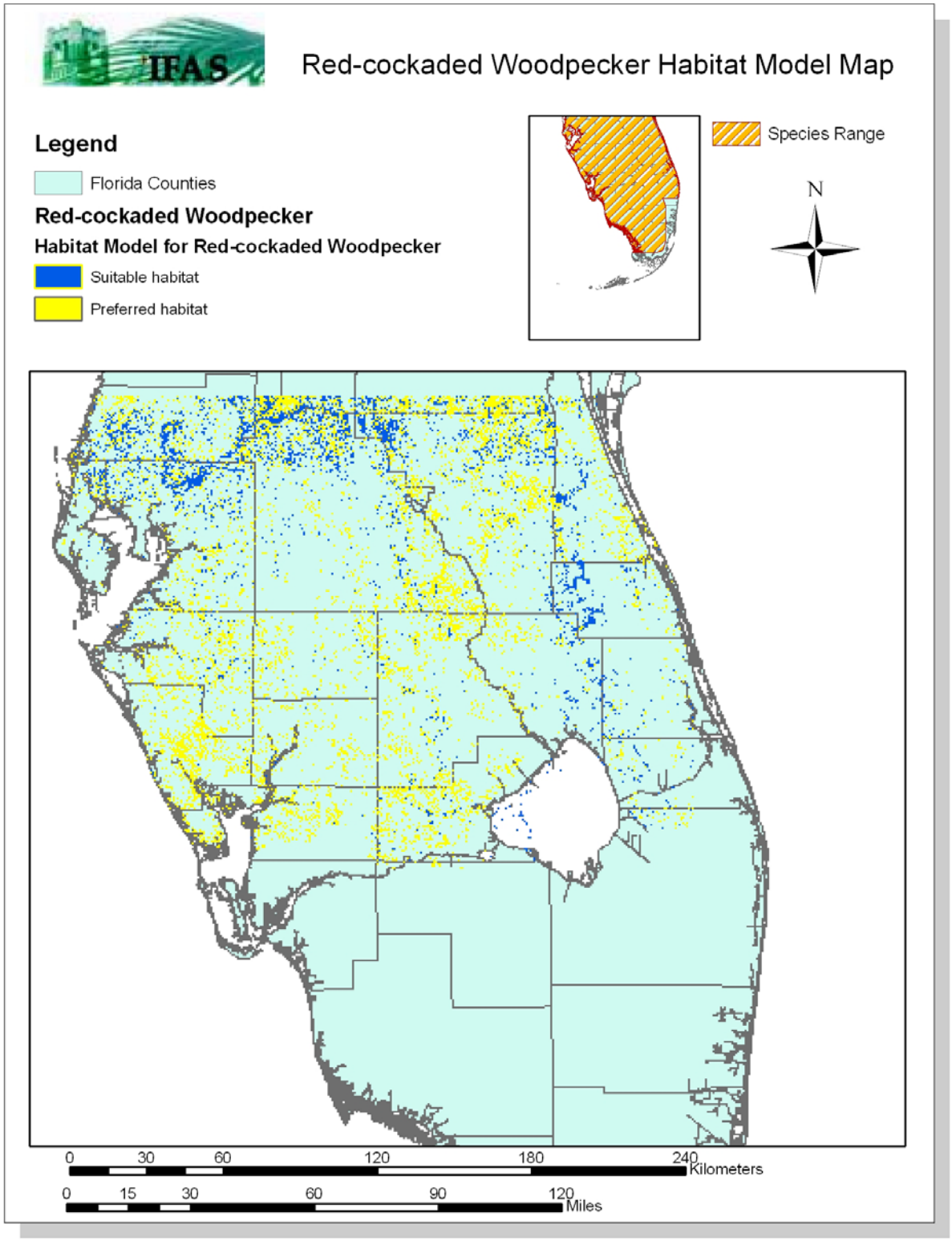

Figure 22. Modeled habitat for Red-Cockaded Woodpecker**,** *Picoides borealis*

Roseate Tern
Sterna dougallii dougallii

Habitat references:
Breeds at Dry Tortugas, and also elsewhere in the Keys, open or sparsely vegetated beaches and spoil islands. Rare in winter. Pelagic or offshore foragers (Layne et al. 1977).
Natural beaches and mudflats, man-made bare ground (Robertson and Kushlan 1984).
Strictly a coastal species, forages over surf near shore, but in the non-breeding season it is pelagic (Stevenson and Anderson 1994).
Nesting on Tortugas, and some of the keys. Nesting on the ground in barren, sparsely vegetated coastal sites such as bare limestone, shell sand beaches, and newly deposited rock and marlble fill (Kale 1978).

1. Roseate Tern breed between Marathon and the Dry Tortugas, though none have nested at the Dry Tortugas for over ten years (W.B. Robertson, Jr. in USFWS 1999) (Figure 23).

2. The following land cover types were identified as potential habitat:

FL GAP land cover classes modeled as **preferred habitat** are:
59- Sand, Beach

FL GAP land cover classes modeled as **suitable habitat** are:
60- Bare Soil/Clearcut

3. No Minimum Critical Area is used for this species (Figure 23).

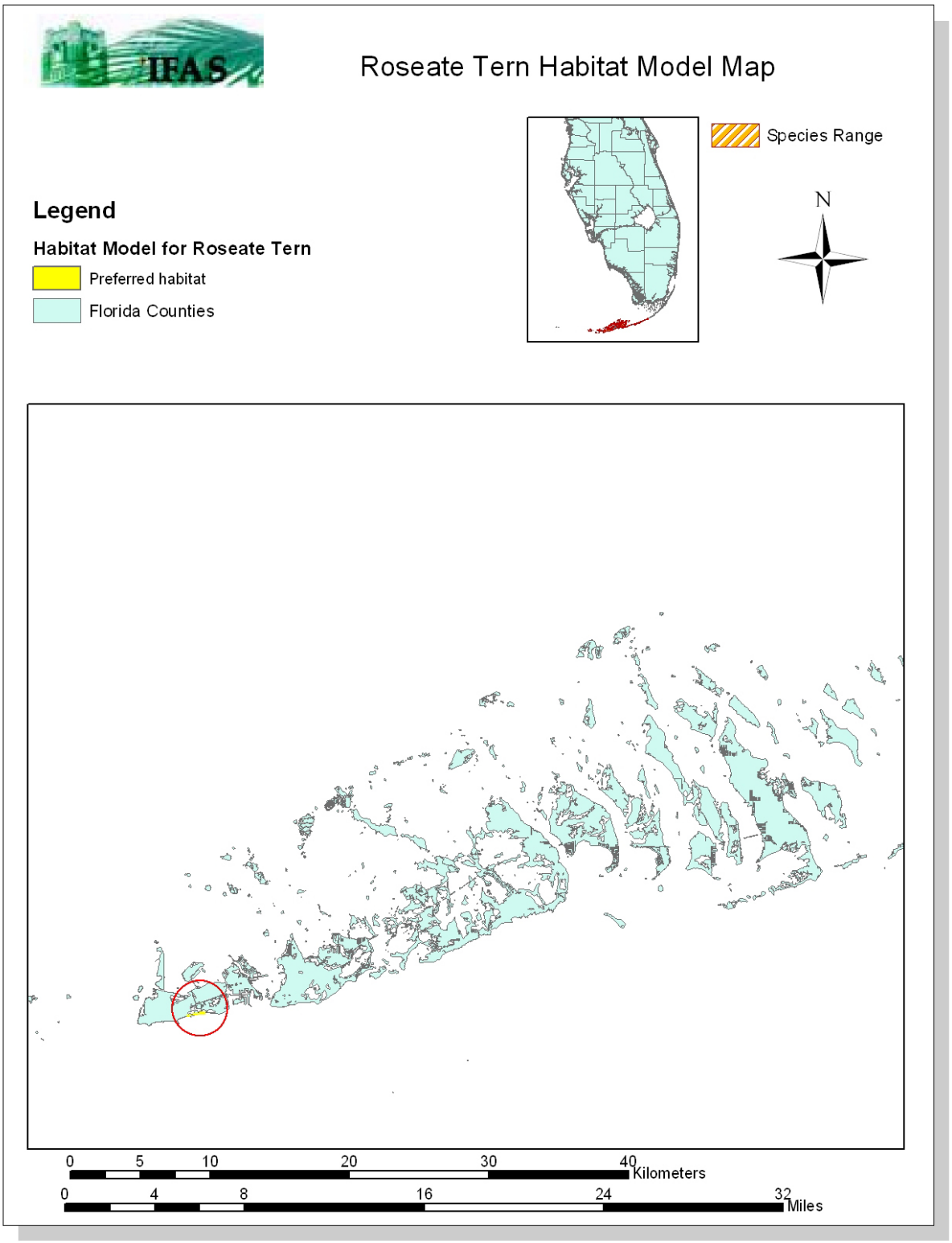

Figure 23. Modeled habitat for Roseate Tern, *Sterna dougallii dougallii*

Reptiles

American Crocodile
Crocodylus acutus

Habitat references:
Prefers edge (first 200m) alone its habitat of mangrove, tropical hammock, fresh and salt water, casuarina, buttonwood, salt marsh, and sand and beach communities (Mazzotti, pers. comm., 2001).
Coastal estuarine swamps and landlocked saline lakes. Mangrove swamps. Up to ""a few miles inland"" (Moler 1992).
Drainage canals, mangrove bordered streams and estuaries (Carr 1940).
Salt bays and mangrove bordered estuaries (Carr and Goin 1955).
Winter distribution generally corresponds with 17 C January isotherm. Prefers relatively deep estuarine habitats protected from wind and wave (Kushlan and Mazzotti 1989a).
Mangrove swamps. Inland ponds and creeks in mangrove swamps, protected coves. Near shorelines. Low salinities mean 14 ppt; higher in summer, thus a preference for fresh to brackish water. In fall and winter, found on inland swamps, bays, and creeks. In spring and summer, also on exposed shores and coves. Average activity area 107 ha with much overlap. Nests on raised creek banks and beach shores in sand marl peat and rocky spoil (Kushlan and Mazzotti 1989b).
Prefer sheltered areas, undercut banks and mangrove snags (Brandt et. al. 1995).

1. The species range (Moler, 1992) stretches from southern Biscayne Bay on the east coast of the peninsula south along the coast through the keys and north to Sanibel Island on the west coast. These models include the historic range of the species, reflecting the increase in populations and range in recent years (Figure 24).

2. Within the range of the American Crocodile, the following land cover types were identified as potential habitat:

FL GAP land cover classes modeled as **preferred habitat** are:
9- Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
20-Buttonwood Woodland
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland

FL GAP land cover classes modeled as **suitable habitat** are:
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest

FL GAP land cover classes modeled as **adjacent habitat** are:
1-Open water

3- Semi-deciduous Tropical/Subtropical Swamp Forest
17- Swamp Forest Ecological Complex
32-Dwarf Mangrove Ecological Complex
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
59- Sand, Beach
64-Urban open/other

3. A minimum critical area (MCA_25) of 2675 hectares (Mazzotti, pers. Comm., 2001) was used. MCA may not be important because the crocodile will use all available habitat (Mazzotti, pers. comm., 2001) (Figure 24).

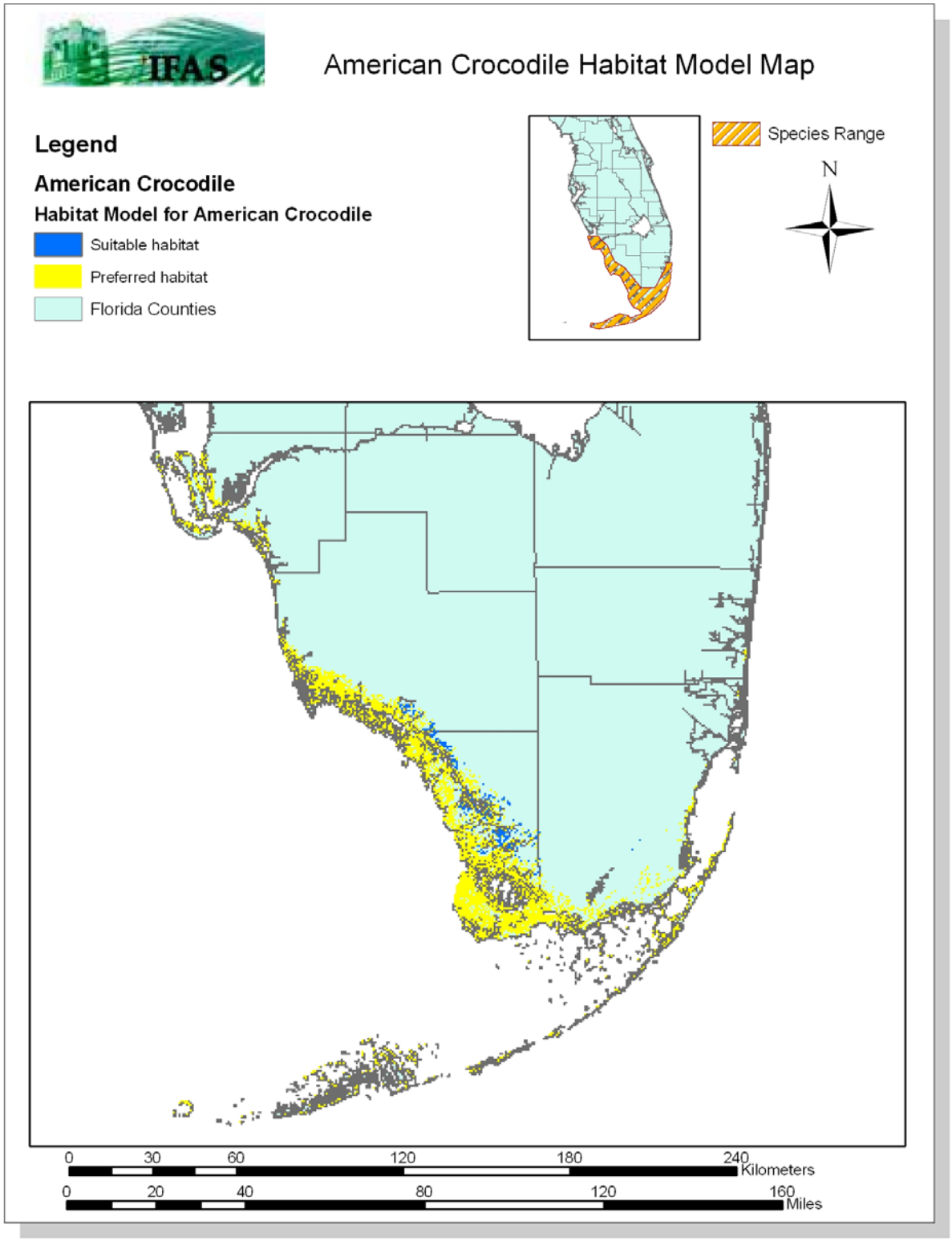

Figure 24. Modeled Habitat for American Crocodile, *Crocodylus acutus*

Bluetail Mole Skink
Eumeces egregius lividus

Habitat references:
Sand pine scrub, rosemary scrub, oak scrub, turkey oak barrens, high pine [longleaf & slash], and xeric hammock. Optimal habitat includes rosemary and oak scrub. Florida keys mole skink found usually on sandy areas near the shoreline, including with driftwood and tidal wrack. Cedar Keys mole skink found under driftwood and tidal wrack, and farther inland in loose sand at the bases of trees (Christman 1992). Mainland populations found on sandhill/longleaf pine, turkey oak and scrub associations, xeric hammocks. High pine and live oak hammocks. On Keys, piles of rocks, debris, and wrack (Carr 1940). Sandy areas. Dry hammocks, old dunes, rosemary scrub, and high pine (Carr and Goin 1955). Fossorial. Sandy or gravelly dry soil. Sandhill and/or scrub associations (Mount 1968).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992) (Figure 25).

2. Within the range of the Bluetail Mole Skink, land cover types were identified as preferred and suitable habitat. Those land covers are:

FL GAP land cover classes modeled as **preferred habitat** are:
4-Xeric-Mesic Live Oak Ecological Complex
35-Xeric Scrubland

FL GAP land cover classes modeled as **suitable habitat** are:
14-Sand Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex
24-Live Oak Woodland
26-Sandhill Ecological Complex
60-Bare Soil/Clearcut

3. No minimum critical area modeled for this species (Figure 25).

Additional Notes:
Trials models suggest that the use of the soil maps to restrict habitat may be too limiting in identifying potential habitat.

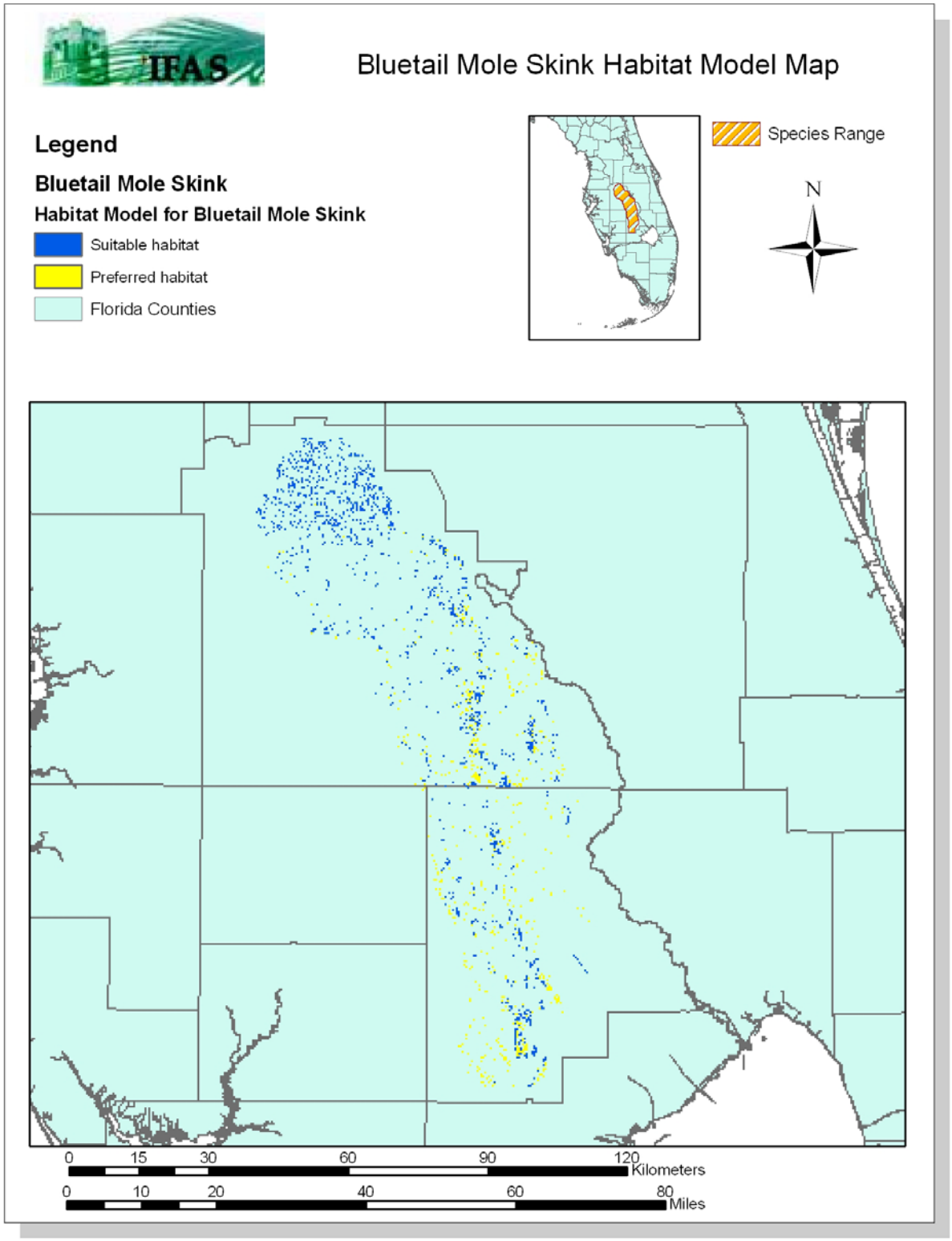

Figure 25. Modeled habitat for Bluetail Mole Skink, *Eumeces egregius lividus*

Sand Skink
Neoseps reynoldsi

Habitat references:
In central Florida, found in rosemary scrub, sand pine scrub, oak scrub, scrubby flatwoods, and turkey oak barrens. Microhabitats with loose sand and sunny exposure. May be present in high pine where wiregrass is gone [doesn't tolerate many roots]. In general, areas of above vegetation without many grasses, low canopy, with scattered shrubs and bare sands (Christman 1992).
Rosemary scrub and high pine (Carr 1940).
Xeric habitats, upland sandhills, sand pine scrub, and turkey oak (Ashton 1988).
Old dunes with light sand, rosemary scrub, and high pine (Carr 1955).
Scrub oak, sand pine, saw palmetto, and rosemary scrub. More open scrub, without rosemary. Seems to prefer moist sand (Cooper 1953).
Longleaf pine/turkey oak sandhills, and sandhill/scrub mixtures. May be abundant in Geomys burrows (Telford 1962).
Scrub. Turkey oak barrens if adjacent to source. Recorded from Osceola county near Loughman (Christman 1988).
Rosemary scrub and high pine, especially the ecotone between rosemary scrub and flatwoods due to moisture levels and prey levels (Telford 1959).

1. Range maps were adapted from the Rare and Endangered Biota of Florida series (Humphrey 1992, Rodgers, *et al*. 1996, Moler 1992) (Figure 26).

2. Within the range of Sand Skink, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
26-Sandhill Ecological Complex
35-Xeric Scrubland

FL GAP land cover classes modeled as **suitable habitat** are:
14-Sand Pine Forest

FL GAP land cover classes modeled as **adjacent habitat** are:
4- Xeric-Mesic Live Oak Ecological Complex
30- Gallberry/Saw Palmetto Shrubland Compositional Group
36- St. Johns Wort Shrubland Compositional Group
59-Sand, Beach
60-Bare Soil/Clearcut

3. No minimum critical area modeled for this species (Figure 26).

Additional Notes: Trials models suggest that the use of the soil maps to restrict habitat may be too limiting .

Consider including the rest of the species' range through Ocala National Park.

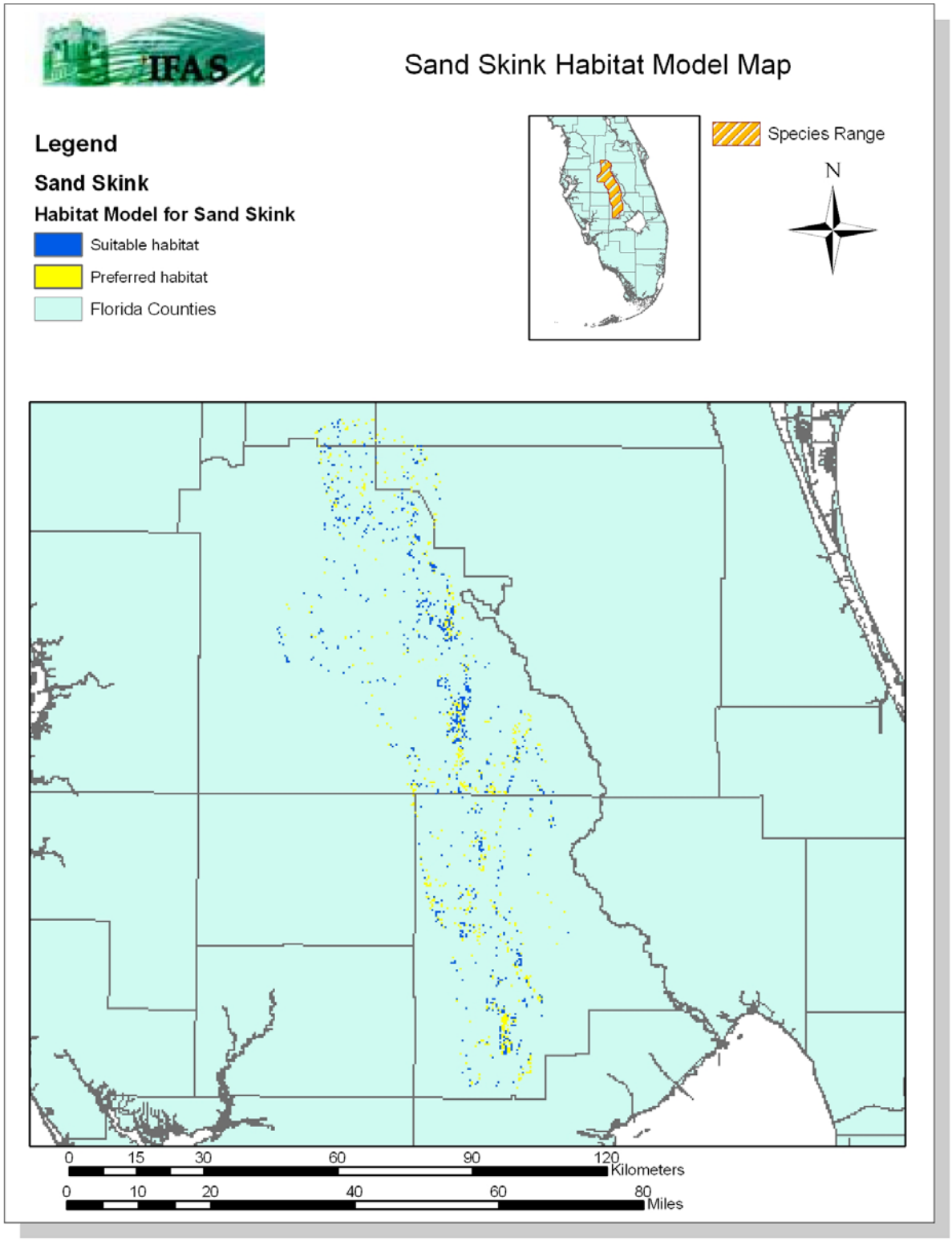

Figure 26. Modeled habitat for Sand Skink**,** *Neoseps reynoldsi*

Atlantic Salt Marsh Snake
Nerodia clarkii taeniata

Habitat references:
Prefers saltwort/glasswort, salt marsh, and saltmarsh cordgrass marsh communites as well as tidal pools and streams (tidal pools and streams are currently being modeled as the first 180 m of saltwater along the coast). It also will use edges (first 180 m) of black needle rush marsh and coastal mangrove communities (<= 180 m from ocean or saltwater) (Moler, 1992). Atlantic salt marsh snake are restricted to brackish, tidal marshes and are most often associated with saltwort flats and salt grass-bordered tidal creeks. It is not known if they occur in the adjacent black needlerush (USFWS 1999).
The snake inhabits coastal salt marshes and mangrove swamps ranging in salinity from brackish to full-strength seawater. It has been observed along ridal creeks, ditches, and pools in associtation with glassworts and black mangrove (Moler 1992).

1. Range maps were modified from peer review. The upper end of the Halifax River near the northern terminus of Volusia County should be the northern extent of the range and southern terminus of Mosquito Lagoon should be the southern terminus (Figure 27)

2. Within the range of the Atlantic Salt Marsh Snake, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
47-Salt Marsh Ecological Complex
49-Black Needle Rush Marsh
50-Saltmarsh Cordgrass Marsh
51-Saltmeadow Cordgrass/Salt Grass Salt Marsh

FL GAP land cover classes modeled as **suitable habitat** are:
9-Mixed Mangrove Forest Formation
10-Black Mangrove Forest
11-Red Mangrove Forest
20-Buttonwood Woodland
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland
32-Dwarf Mangrove Ecological Complex
38-Saltwort/ Glaswort Ecological Complex
49-Black Needle Rush Marsh

3. No minimum critical area modeled for this species (Figure 27).

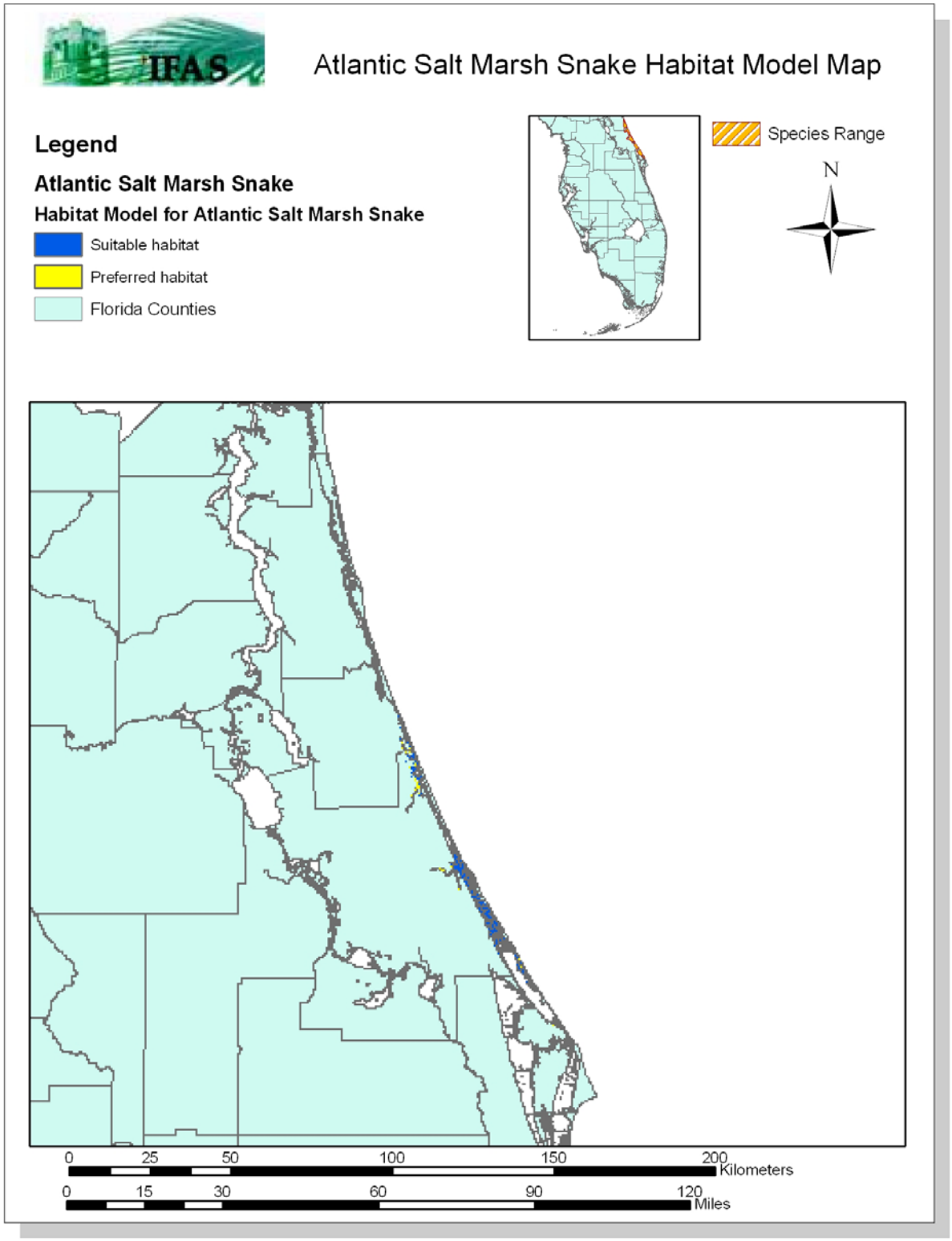

Figure 27. Modeled habitat for Atlantic Salt Marsh Snake, *Nerodia clarkii taeniata*

Eastern Indigo Snake
Drymarchon corais couperi

Habitat references:
Eastern indigo snake habitat ranges from mangrove swamps and wet prairies to xeric pinelands and scrub. Often winters in gopher tortoise burrows in north Florida (Moler 1992). They use high dry areas adjacent to water, but in south Florida they may be found along canals, wet fields, and maybe mangrove swamps. Crab holes and stump holes may be used as refugia instead of gopher tortoise burrows (Ernst and Barbour 1989).
Snakes are found in pine flatwoods in north and central Florida. In south Florida they are found in dry glades, tropical hammocks, and muckland fields (Carr and Goin 1955).
South of Okeechobee, they are common on canal banks, and australian pine hammocks (Lawler 1977).
Snakes are common in coastal scrub (Fernald 1989)

1. The range of the Eastern Indigo Snake includes all of south Florida (Figure 28).

2. Within the range of the Eastern Indigo Snake, land cover types were identified as:

FL GAP land cover classes modeled as **preferred habitat** are:
2-Tropical Hardwood Hammock Formation
4-Xeric-Mesic Live Oak Ecological Complex
5-Mesic-Hydric Live Oak/ Sabal Palm Ecological Complex
13-South Florida Slash Pine Forest
14-Sand Pine Forest
15-Xeric-Mesic Mixed Pine/Oak Forest Ecological Complex
16- Mesic-Hydric Pine Forest Compositional Group
20-Buttonwood Woodland
24-Live Oak Woodland
25-South Florida Slash Pine Woodland
26-Sandhill Ecological Complex
27-Broad-leaved Evergreen and Mixed Evergreen/Cold-deciduous forest
29- Dry Prairie (Xeric-Mesic) Ecological Complex
30-Gallberry/Saw Palmetto Shrubland Compositional Group
33-Coastal Strand
35-Xeric Scrubland
39-Graminiod Dry Prairie Ecological Complex
41-Wiregrass Grassland

FL GAP land cover classes modeled as **adjacent habitat** are:
3-Semi-deciduous Tropical/Subtropical Swamp Forest
6-Bay/Gum/Cypress Ecological Complex
7-Loblolly Bay Forest
8-Cajeput Forest Compositional Group
9-Mixed Mangrove Forest Formation

10-Black Mangrove Forest
11-Red Mangrove Forest
17-Swamp Forest Ecological Complex
18-Cypress Forest Compositional Group
19-Mixed Evergreen.Cold-deciduous Hardwood Forest
21-Mixed Mangrove Woodland
22-Black Mangrove Woodland
23-Red Mangrove Woodland
28-Flooded Broad-leaved Evergreen and Mixed Evergreen/Cold-decid forest
31-Brazilian Pepper Shrubland
32-Dwarf Mangrove Ecological Complex
34-Groundsel-tree/Marsh Elder Tidal Shrubland
36-St. Johns Wort Shrubland Compositional Group
37-Saturated-Flooded Cold-deciduous and Mixed Evergreen Shrubland
40-Sea Oats Dune Grassland
52-Sparsely Wooded Wet Prairie Compositional Group
53-Dwarf Cypress Prairie
54-Temperate Wet Prairie
55-Maidencane Marsh
59-Sand, Beach
65-Agriculture
66-Pasture/Grassland/Agriculture
67-Agriculture/Groves/Ornamental
70-Recreation

3. No minimum critical area modeled for this species (Figure 28).

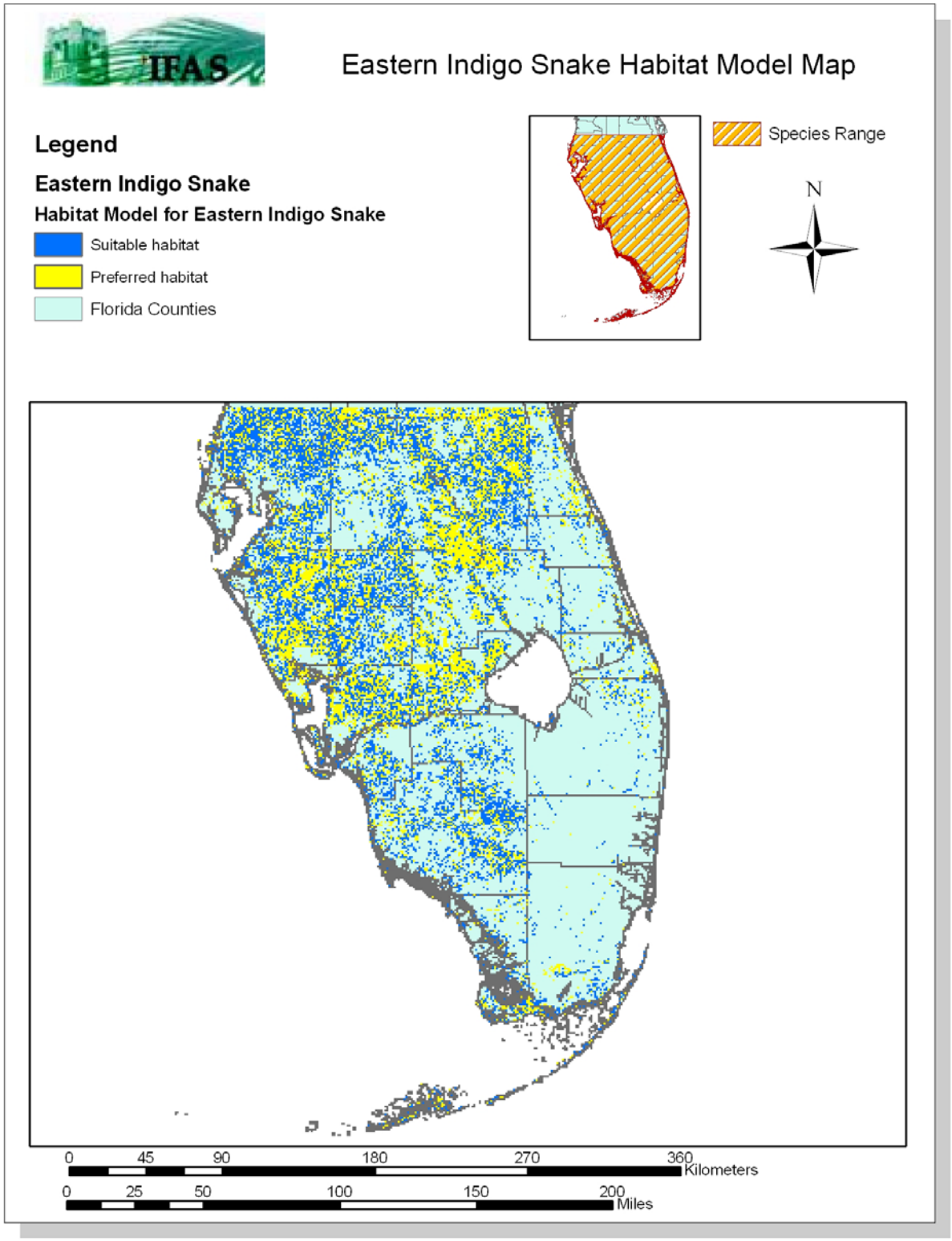

Figure 28. Modeled habitat for Eastern Indigo Snake, *Drymarchon corais couperi*

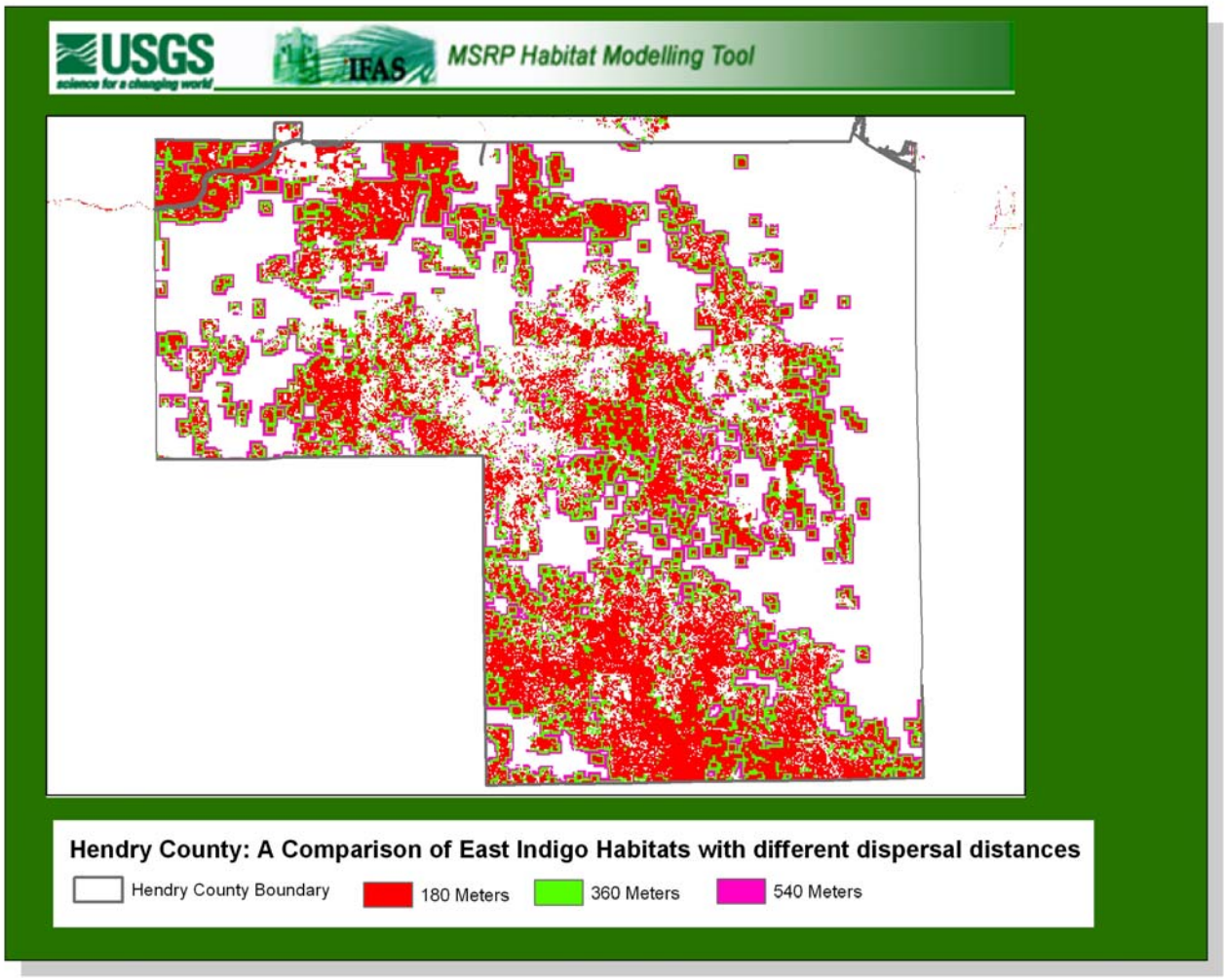

Figure 29. Illustration of the modeled change in Eastern Indigo Snake habitat when different dispersal distances to adjacent habitat are considered.

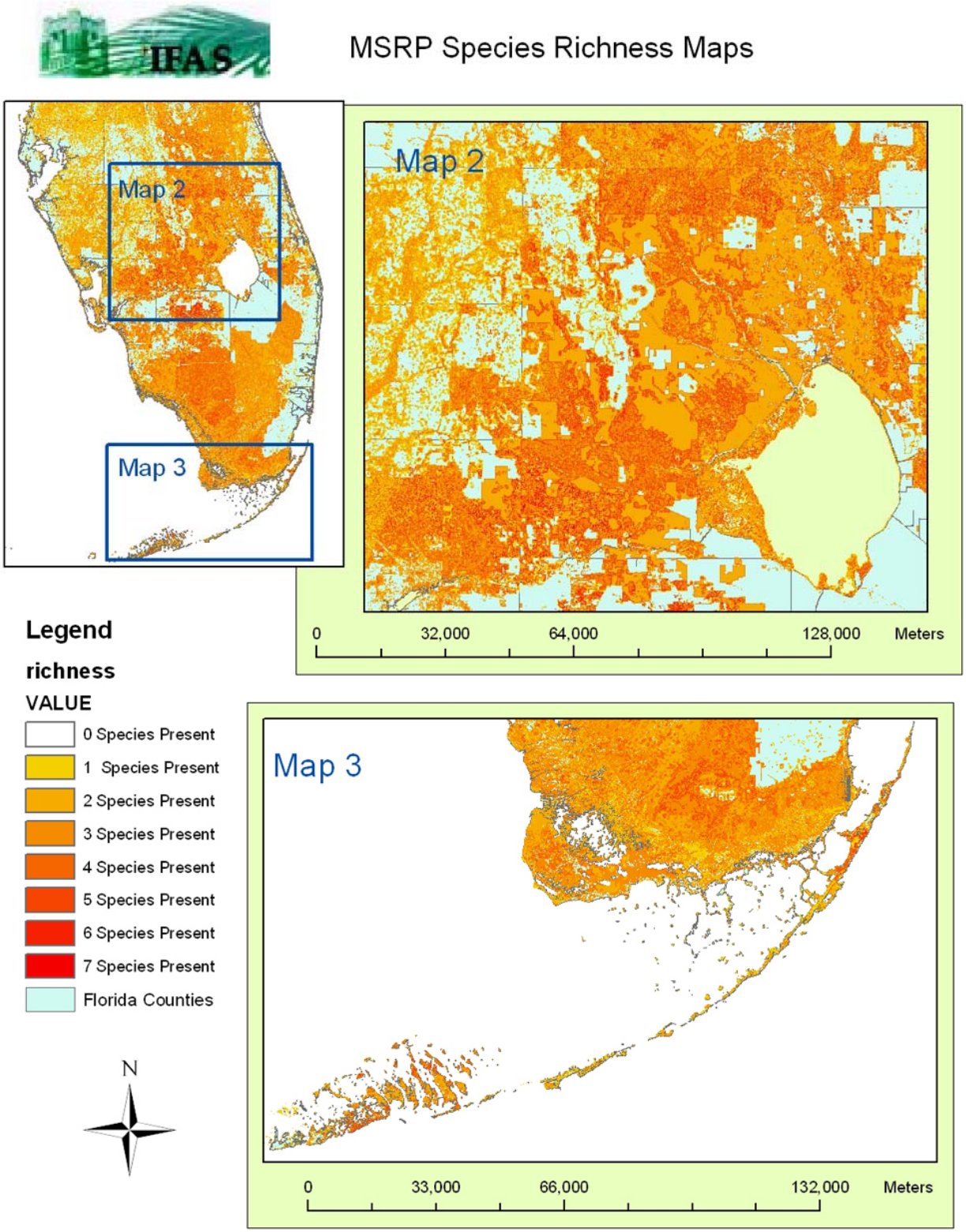

Figure 30. Potential species habitat richness for the 22 threatened and Endangered terrestrial vertebrates in the MSRP habitat models.

Recommendations for Risk Assessment and Prioritization of Habitats

During the peer review process for the models, the reviewers were asked their opinions on existing data or modeling techniques that could be used to prioritize potential habitat for land protection efforts. The following is a summary of their responses.

Florida Keys restricted species

- Six of the modeled threatened and endangered species have ranges restricted to parts of the Florida Keys. The species are all small mammals and a bird (Roseate Tern) that can use small parcels of the landscape, so a finer resolution mapping of land cover within the Keys may improve habitat identification. The Florida Department of Environmental Protection ADID mapping and the FL Keys Carrying Capacity Study are both sources for finer resolution land cover classification.

Key Deer

- Monroe County is prioritizing Key Deer habitat.

- Talk to Randy Kautz about Key Deer viability assessment.

Key Largo Cotton Mouse

- Habitat diversity is very important. Areas containing mangrove, saltmarsh, and freshwater marshes are most important. However, at what scale should such an analysis be conducted (1 square kilometer or less)?

- Large expanses containing the entire habitat gradient (mangroves, saltmarsh, freshwater marsh) are most important. However, what would be the threshold for identifying "large expanses" or should a set of patch size classes be used to prioritize patches containing all three major habitat categories?

Southeastern Beach Mouse

- The group discussion then revolved around defining dispersal distance and suitable "matrix habitat" for identifying nearby cover types that might support mice. This is based on the research finding that beach mice have been found significant distances (need number here) from dunes and coastal strand in other suitable cover types inland within then Canveral National Seashore/Merritt Island National Wildlife Refuge. Apparently these mice are able to move through other natural or semi-natural cover types to reach more inland habitats. The group consensus is that all cover types other than residential or urban should be considered traversable. However, we do not have any firm numbers on acceptable dispersal distance. One suggestion was to look at the species description in Don Wood's "Florida's Fragile Wildlife" book. In addition, the

FCREPA account (Stout 1992) mentions that ruderal habitats 1 km from dunes support this subspecies on Cape Canaveral.

Lower Keys Marsh Rabbit

- Talk to Craig Faulhaber about his habitat prioritization scheme.

- Identification of areas adequately buffered from urban/residential land uses is important because predation is greatly increased near such development. However, what would be a satisfactory distance(s) for characterizing a predation threshold or gradient?

Key Largo Woodrat

- Britt Keith's thesis work could be used as the basis for developing a prioritized habitat suitability map.

Crested Caracara

- Joan Morrison is working on a habitat suitability model with the FWC: "I am currently working under contract with the FWC, specifically with Randy Kautz and his shop, to create a habitat suitability model for the crested caracara in Florida. We are developing this model using known nest locations, locations of radiotagged juveniles in gathering areas, and information about home range area for breeding adults. Perhaps we should talk about this or at least all work together, so there is no duplication of effort, so the best data available are used, and so that the result of the effort is a map that will really be useful in evaluating suitability of habitat for the species across central Florida."

Bald Eagle

To prioritize Bald Eagle habitat two approaches were discussed:

- Buffering known nest locations and/or identifying areas of high nest density such as done if the Florida Fish and Wildlife Conservation Commission (FWC) Strategic Habitat Conservation Analysis (Cox et al. 1994).

- Explore the potential use of the BEHIV (Bald Eagle Habitat Index of Vulnerability) model being developed for the Florida Department of Transportation with Steve Nesbitt from FWC.

Florida Scrub-Jay

- It was also suggested that we may want to refer to both the 1992-1995 Survey data and FNAI element occurrence data as part of habitat modeling or prioritization. Known occurrences or populations could be used as an additional seed/source just

like xeric scrubland to identify preferred/suitable/adjacent habitat within an accepted distance. We should also consider assessing what cover types are found where there are populations but no xeric scrubland to determine if any additional cover types might need to be identified as habitat. Distances suggested for identifying additional habitat around xeric scrubland or known populations was 720-1000 meters.

- Appropriate soils could be another means for identifying potential habitat on the Lake Wales Ridge (and elsewhere?) and/or a way to identify restoration potential.

- Use the conclusions of the recovery team regarding habitat conservation priorities.

- Coordinate with the recovery team to potentially combine approaches/efforts.

- Combine occurrence-based metapopulation models with potential habitat.

<u>Everglades Snail Kite</u>

- Temporal changes in hydrology and water management are extremely important variables determining habitat use. Incorporation of data on hydrology during wet/dry cycles is important for making predictions of habitat use. However, because hydrologic conditions in south Florida are highly dynamic and for the purpose of measuring potential biodiversity across a landscape, all potential habitat needs to be considered, not just the habitat that currently has appropriate hydrological conditions. The MSRP model, over a broad extent, says "all of this area is potential habitat at some point (i.e., when water conditions are correct) and so should be considered for conservation". These GAP-type models have been criticized for being a single snap-shot in time because they are based on a land cover classification from a single date, but really, in this case, they are more of an aggregation of times because the land cover itself is not changing (unless it is developed)—rather there is a dynamic of water cycles within that land cover that causes the kites to move around (again, within that land cover). It would be a mistake to try to narrow potential habitat any more than that because they will use all of the marsh at some time and they are still showing up at surprising places (Kitchens, person. comm.). The result is a habitat map that is purposefully broad for the purposes of considering habitat for conservation.

- To prioritize the potential habitat, however, hydrologic influences on habitat quality must be considered. The EVERKITE and ATLSS SESI Snail Kite models are appropriate for this within the extent for which spatial hydrologic stage and duration modeling is available. Currently, that restricts the use of the EVERKITE and SESI models to the Everglades proper. Hydrologic models are being developed for southwest Florida that may extend the application of the EVERKITE and SESI models to that area. North of Lake Okeechobee, we may be able to use lake records and other data along with the known nesting/forage/refugia sites to help those evaluations (and possibly id unknown areas with similar landscape character).

- The recommendation for prioritizing potential habitat included identifying:
    - all known nesting sites
    - all known foraging sites
    - all known refugia sites
    - identification of all impoundments or agricultural water retention systems that are most likely to serve as refugia.

Florida Grasshopper Sparrow

- Avoidance of certain cover types should also be modeled. Areas with high densities of hammocks are avoided and large hammocks are avoided.

- An avoidance edge effect should also be modeled for all cover types NOT included as habitat. This would also require a defendable avoidance distance be selected.

- There needs to be more work on year round habitat use.

- Dry prairie should be considered most important. Also larger blocks of dry prairie should be ranked higher.

- Forty-four hectares could be used as an important threshold for prioritization. Mike Delany recommends this be used in the potential habitat model to eliminate patches smaller than 44 hectares.

- Known populations/occurrences should also be used, which could include data from FNAI, FWC , and Mike Delany However, older FNAI records should be handled carefully, including deleting occurrences where cover has changed, and making sure that records represent Florida subspecies.

- Consult with FNAI regarding their model used in the Florida Forever Needs Assessment as well.

- Dispersal distances should be used to prioritize habitat nearer to known locations. Dispersal distances may range from 2 kilometers to 26-29 kilometers. Dustin Perkins stated that: "I think it is very unlikely that birds will turn up in areas further than 15-20 km from the current sites."

- Dustin Perkins stated: "As far as priority, the larger the better, these birds do not like trees and small isolated prairies would not be sustainable. Perkins has a paper in Journal of Wildlife Management (In Press) describing the core-edge relationship for these birds that may be of use. Emphasis patches closer to populations first, then disjunct patches.

- Higher priority to parcels that will not be grazed after purchase versus ones that will continue to have cattle on them. If there are cattle on them now, but they will not have cattle on them in the future this should not be weighed against that parcel unless

it is severely degraded. Kissimmee Prairie has shown that parcels that did have cattle prior to being purchased on them can provide excellent habitat, and they have also shown that prairie that has not been burned in a long time can be restored by roller-chopping and summer fires, and can provide suitable habitat.

- In regards to negative edge effects and critical patch sizes the following is extracted from the In Press journal article abstract sent by Dustin Perkins: "For Florida grasshopper sparrows, we found that core areas >400m from edge were consistently sources. We believe that the only way Florida grasshopper sparrows can persist at these sites is if the core source areas produce enough surplus young to compensate for the sink habitat along the wide borders of these prairie fragments." . . . "We believe that large prairie fragments, possibly >4,000ha, are necessary for maintaining source habitat for Florida grasshopper sparrows and possibly other grassland bird species."

<u>Wood Stork</u>

- To prioritize habitats, the general approach taken by the Florida Fish and Wildlife Conservation Commission in their Strategic Habitat Conservation Areas analysis (Cox et al. 1994) may be relevant. First they identified primary habitat as all wetland areas within 30 kilometers of known nesting locations. Strategic Habitat Conservation Areas were identified as all wetland areas within 15 kilometers of known nesting locations. However, Peter Frederick indicated that he thought longer distances would probably more appropriate, with potential regional differences such as larger buffers in south Florida and smaller buffers in north Florida. It was also stated that if you use large buffers, such as 30-50 kilometers, based on the distribution of nesting sites most or all of the wetlands in the state could end up being identified as high priority. If nesting site buffers are used, it was also recommended that both existing and historical rookery sites be used.

- Another consideration for prioritization would be to rank graminoid/herbaceous and open canopy wetlands higher than closed canopy wetlands.

<u>Red-cockaded Woodpecker</u>

- Since objectives for the GAP MSRP are to 'develop reserve design recommendations and identify land protection priorities', the highest priority habitat should be any preferred or suitable habitat near or within existing populations of RCWs. However the model doesn't need to be exclusive of other suitable habitat, particularly if it is in close proximity to a current RCW population.

- The FWC model describes habitat within 500 meters of active rcw clusters as "core habitat areas". The next highest priority for additional suitable or preferred habitat would occur within the dispersal distance from active rcw clusters—6 km., 12 km., and 24 km with habitat within 24 km as the lowest priority.

- A series of papers have addressed the viability of RCW populations with respect to the spatial arrangement of clusters which may be relevant here including: Walters, J. R., L. B. Crowder, and J. A. Priddy. 2002. Population viability analysis for red-cockaded woodpeckers using an individual-based model. Ecological Applications 12:249-260. and other papers referenced in this one.

Bluetail Mole Skink

- If a minimum critical area was used to identify potential habitat or prioritize, 25 hectares would be way too large because densities are likely much higher than estimated in Cox and Kautz 2000. 0.5 acres to 4 acres might be more appropriate as a minimum area baseline.

Sand Skink

- Need to study sand skink presence in old or abandoned orange groves with suitable soils. Sand skinks have been found on such sites. Hilary Swain should be contacted regarding an orange grove study around US 27.

- Soil data in combination with elevation data could be used to augment the identification of suitable habitat types mentioned above or other suitable land cover types with appropriate soils and location. Only extremely well-drained soils and elevations over 85 feet should be considered.

- If a minimum critical area is used in either the potential habitat model or in prioritization, measured densities range from 12-80 individuals per 0.16 hectares. Contact Kyle Ashton for exact numbers.

Atlantic saltmarsh snake

- Threats: Marinas and other developments are still occurring in saltmarsh habitat.

- Restoration: Restoring ditched wetlands and impounded saltmarsh are important for improving habitat conditions.

Eastern indigo snake

- Big patches are better. Use class 1 roads from 1:24 roads to demarcate habitat patches and then rank (maybe on a scale of 1-9 0r 1-10) using a continuous scale (e.g., equal interval I guess).

- Low road densities are better. Use all roads to calculate road density and rank habitat on a continuous scale.

- Areas with a mixture of uplands and wetlands are preferred. Consider ranking areas based on the diversity of uplands and wetlands

- Urban edges are bad and patch shape matters. So consider:
    - ranking habitat based on distance from urban land uses.
    - Calculating patch shape and rank patches with larger interiors higher.

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