# Everglades National Park Biodiversity

South Florida Natural Resource Center

**National Park Service**
**U.S. Department of the Interior**

# Does What We Know about Biodiversity Have a Place in Restoration Planning?

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**Why is this question important?**

In 1934, Everglades National Park (EVER) became the first park to have its biodiversity recognized in its enabling legislation. The diversity of species has often been considered a good indicator of detectable environmental change. This has made tracking biodiversity key toward the NPS and EVER mission of "preserving ...diversity, abundance and ecological integrity of its unique flora and fauna."

Everglades Restoration Indicators

Everglades restoration planning activities have viewed indicators as performance measures of restoration success. Performance measures have numerical targets while indicators may only summarize status and trends data. Indicators used to assess Everglades restoration activities focus on specific problems with specific remedies, which have primarily been the re-design and fine-tuning of the C&SF project. Biodiversity may not fit well in the context of Everglades restoration indicators unless a target is defined and corrective actions described that can be implemented. There are indicators in use that address biodiversity indirectly, but there is currently no indicator that requires the monitoring and tracking specifically of biodiversity as a measure of restoration success with the exception of Florida Bay seagrasses.

One of the concerns of using biodiversity as an indicator of success has been that it is already addressed by tracking the populations of threatened and endangered species (T&E) and non-native species. Moreover, biodiversity measurements using species richness alone can be considered "good enough", but the information of how even the distribution of rare to common species are in the community of a habitat or landscape region is not being monitored. The costs of time and money associated with obtaining abundance information for more species alone has put biodiversity in a tenuous place as an indicator for restoration.

The current set of system-wide indicators used by RECOVER were vetted through peer review and published in Doren et al. (2009). Potential threats to biodiversity such as the status of threatened and endangered (T&E) species as an indicator criteria and the spread of exotic animals were not included in the final set of system-wide indicators. Both of these potential indicators are addressed in the NEPA environmental assessments and environmental impact statements for individual CERP and non-CERP restoration projects.

Table 1. A summary of the numbers of native species and families by taxonomic group taken from Table 436 in the EVER NRCA (National Park Service, *in press*). Taxonomic groups not in italics are in NPSpecies—an online database of organisms present in many of the NPS administered lands.

| Taxonomic Group | Estimate of Native Species | Families of Species Estimated Present | Indicator Groups Under Study |
|---|---|---|---|
| Birds | 341 | 53 | wading birds, at-risk, non-native |
| Mammals | 41 | 14 | small prey, at-risk |
| Fish | 385 | 86 | marsh fish, sport fish, at-risk, non-native |
| Reptiles | 68 | 15 | alligators, crocodiles, at-risk, non-native |
| Amphibians | 19 | 9 | currently none |
| Vascular plants | 732 | 160 | All major habitat types, at-risk, non-native, seagrasses |
| *Insects: Butterflies and Skippers* | 95 | 12 | at-risk |
| *Insects: Dragonfiles* | 63 | 6 | currently none |
| *Insects: Midges* | 126 | TBD | currently none |
| *Crab/Lobster/Shrimp* | 6 | TBD | currently none |
| *Other crustaceans: Copepods* | 39 | TBD | currently none |
| *Spiders/Scorpions* | 800 | TBD | currently none |
| *Slugs/Snails* | TBD | TBD | at-risk, non-native |
| *Non-vascular plants: Periphyton* | TBD | TBD | response to water quality |
| *Fungi (lichens)* | 500 | TBD | currently none |
| *Protozoa* | TBD | TBD | currently none |
| *Chromista* | TBD | TBD | currently none |

## The Beginning of an Answer

The "stoplight assessment" created by Doren et al. (2009) was used for the National Resources Conditions Assessment (NRCA biodiversity assessment National Park Service (*in press*). The estimate of the numbers of native species for the major taxonomic groups found in EVER is in Table 1. The number of at-risk (T&E and species of special concern) and non-native species are shown in Table 2. Based on species richness, native biodiversity overall appears stable based on species richness (Table 3). However, the status of T&E and non-native species appear to be worsening, which will affect the condition of overall biodiversity.

Table 2. A summary of the number of At-risk (T&E and species of special concern) and Non-native species and proportions taken from Table 4.34 in the EVER NCRA (National Park Service, *in press*).

| Taxonomic Group | #At-risk species | % of native species that are At-risk | #Non-Native Species | % of all species that are Non-native compared to total number of species |
|---|---|---|---|---|
| **Birds** | 71 | 20.82% | 22 | 6.06% |
| **Mammals** | 15 | 36.59% | 9 | 18.00% |
| **Fish** | 14 | 3.64% | 11 | 2.78% |
| **Reptiles** | 10 | 14.71% | 26 | 27.66% |
| **Amphibians** | 0 | 0.00% | 3 | 13.64% |
| **Plants** | 151 | 20.63% | 291 | 28.45% |
| **Total** | 261 | | 362 | |

The most recent National Research Council (NRC) assessment does not address biodiversity as an indicator of restoration success except by acknowledging that the increase in non-native species may be impacting native biodiversity and refers to other large watersheds that are experiencing the same impacts (NRC 2014).

As a World Heritage Site, EVER reports the status of its natural resources to UNESCO. Like the RECOVER assessments, the World Heritage reports include the status on the abundance, diversity and distribution of submersed aquatic vegetation in Florida Bay, but not on the biodiversity of other ecosystems (Mitchell and Johnson, 2013a, 2015). The report of EVER ecological indicators are the same as those used for the World Heritage report (Mitchell and Johnson, 2013b).

Table 3. A summary of the biodiversity and at-risk biota metrics taken from Table 4.35 in the EVER NRCA (National Park Service, in press) following Doren et al.'s (2009) "assessment stoplight" methodology.

| Metric | Integrity Measure | Condition | Rationale |
|---|---|---|---|
| **Birds** | Proportion at risk | ⇩ | Seventy one (20%) of the 341 native bird species in EVER are considered at-risk. Migratory populations incur significant risk outside EVER. |
| | % Non-Native Species | ⇩ | Twenty two of the 363 species of birds present in EVER (6%) are non-native. |
| | Risk pool | ⇩ | 125 non-native species are establish in Florida, but not yet in EVER, which has 341 native bird species. |
| **Mammals** | Proportion at risk | ⇩ | Fifteen of the 41 native mammal species (37 %) are listed as special status. |
| | % Non-Native Species | ⇩ | Nine of 50 total mammal species found in EVER (18%) are non-native. |
| | Risk pool | ⇩ | Seventeen exotic mammals are established in FL, but not present in EVER, which has 41 native mammal species. |
| **Fish** | Proportion at risk | ⇔ | Fourteen of 385 fish species (4%) are considered at-risk EVER. Many small/cryptic fish species are included in this list, and thought to occur, but have not been observed in EVER. |
| | % Non-Native Species | ⇔ | Less than 3% of all species are non-native. Many small/cryptic fish species are thought to occur, but have not been observed. |
| | Risk pool | ⇩ | Twenty three non-native fish are known to be established in Florida, but are not present in EVER, which has 385 native fish species. |
| **Reptiles** | Proportion at risk | ⇩ | Ten of the 68 native species (15%) of reptiles in EVER are at-risk. |
| | % Non-Native Species | ⇩ | Twenty six of the 94 total reptile species observed in EVER are non-native. The Burmese python is the most well-known non-native reptile. |
| | Risk pool | ⇩ | 109 reptile species are naturalized in Florida, but not present in EVER. This is almost double the number of native reptiles. |
| **Amphibians** | Proportion at risk | ⇔ | There are no known at-risk amphibians in EVER. Globally, amphibian species are thought to be in decline. |
| | % Non-Native Species | ⇩ | Three of the 22 amphibian species (14%) present in EVER are non-native. |
| | Risk pool | ⇩ | Eleven amphibian species are naturalized in Florida, but not yet detected in EVER, which has 19 native amphibian species. |
| **Plants** | Proportion at risk | ⇩ | 151 plant species are considered at-risk. Of 732 native plants species estimated to occur in EVER. |
| | % Non-Native Species | ⇩ | 291 of the 1023 plant species (28%) in EVER are non-native. |
| | Risk pool | ⇩ | 170 plant species are naturalized in FL, but not yet present in EVER, which has 732 native plant species. |

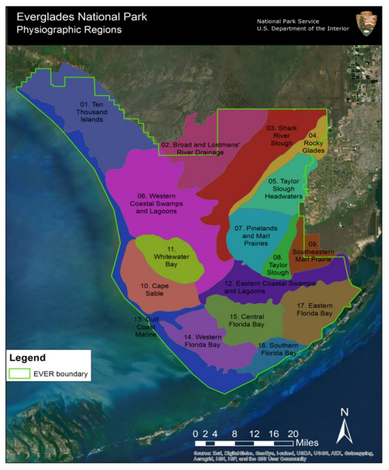


Figure 1. Map of EVER's physiographic regions taken from Figure 4.71 in the EVER NRCA (National Park Service, *in press*).

Biodiversity information is typically summarized across a range of spatial scales. Scientists and natural resource managers can assemble locally collected biodiversity data to compare the health of individual habitats and diagnose more complex management challenges across gradients of environmental stress. The EVER NRCA used 17 physiographic regions show in Figure 1. Figures 2-6 show the species richness for birds, mammals, fish, reptiles and amphibian and the predicted distribution of species richness. The results are from a series of NPS Natural Resource Reports (NRRs) (Howington 2015a, b, c, and d) that were written after the NRCA in an attempt to reconcile multiple species lists. The distribution is the same as in the NRCA, but there is some refinement to the number of species shown in Table 2. Both the NRCA and NRR series were written with the assistance of the South Florida and Caribbean Monitoring and Inventory Network.

The distribution of species richness suggest that biodiversity might need to be studied more closely in those areas of the park were native biodiversity is highest because this is where non-native biodiversity is highest. A closer look at the habitats within each physiographic region is also informative.

Figures 2-6. The distribution of species richness in EVER from Howington (2015a, b, c, and d).

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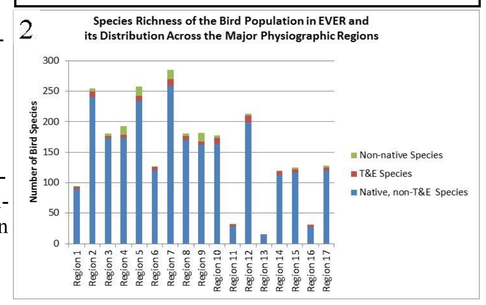


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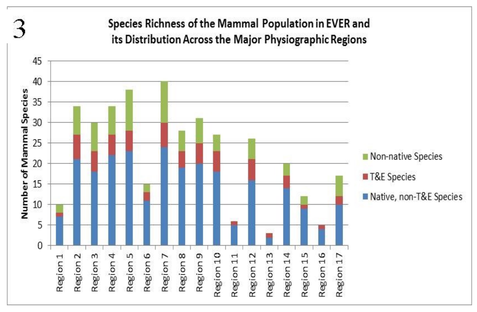


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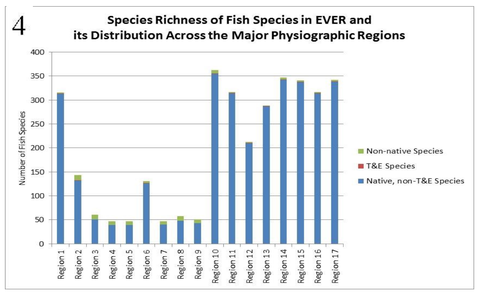


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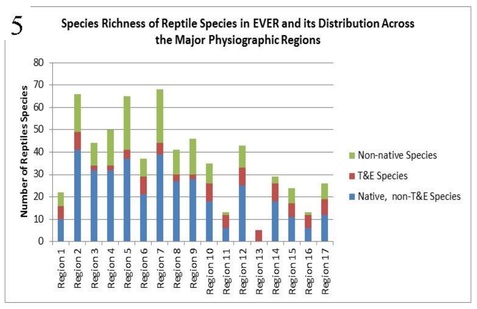


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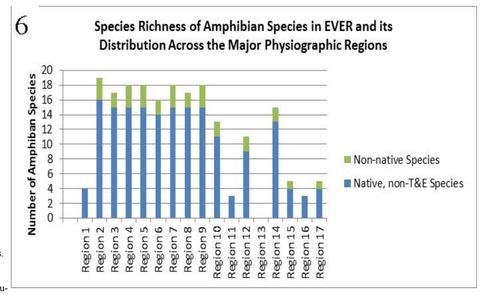


## Conclusions

Biodiversity as an indicator may not produce unique design solutions for restoration projects, beyond that provided by current indicators (performance measures). However, measurement of biodiversity constitutes an ecosystem-wide characteristic that integrates and reflects the health of a number of other physical and ecological components of the system. It may be beneficial to track system-wide biodiversity in a large landscape system such as the Everglades that is affected by numerous large scale factors (water management, invasive species, and increasingly climate change).

Climate change is predicted to affect the same attributes of EVER's natural resources as altered hydrology only over a longer undefined time period and restoration to former historical targeted conditions will be a much more difficult challenge. Pearlstine et al. (2009) summarized predictions of how climate change will cause EVER's natural resources some level of impairment based on published scientific literature available at that time. Pearlstine et al. (2010) focused on how climate change will test the resilience of the large Everglades landscapes and management implications. Watling et al. (2013, 2014) and Bucklin et al. (2015) and other collaborative publications have begun to explore the use of climate envelopes to predict how temperature changes and sea level rise will alter habitats and potentially provoke a migration, expansion, or local extinction of T&E and non-native species populations. Most recently, Ross et al. (2016) analyzed climate induces changes on the species composition and richness of the tree species in south Florida hardwood hammock community.

The emergence of hybrid species is emerging as another potential threat to biodiversity in wilderness areas. The future of biodiversity as an indicator is uncertain, but what is certain is that altered hydrology and climate change has changed and will change further the species composition, the number of species, and abundance of species of Everglades environments.

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Protecting biodiversity is important for Everglades National Park (EVER). EVER was the first park to have its biodiversity recognized in its enabling legislation enacted in 1934. Field monitoring in EVER is challenging, and consequently, elucidating details of the park's biodiversity is a slow and complicated effort. In order to progress more rapidly, EVER updated the dataset of species and habitat associations developed under a project funded by the Critical Ecosystems Studies Initiative (CESI) using a comprehensive literature review that included citizen science databases. EVER is recommending that the South Florida and Caribbean Inventory and Monitoring Network (SFCN) use the CESI dataset to update the internet accessible species lists on the National Park Service website https://irma.nps.gov/NPSpecies/ (NPSpecies). The SFCN provided a quality assurance and quality control (QAQC) analysis of the updated CESI species lists. Predictions were made of the spatial distribution of species by comparing their preferred habitats to vegetative communities found within EVER's physiographic regions.

Each report addresses the species found within EVER within the same taxonomic group of birds, mammals, fish, or reptiles and amphibians These analyses refined our understanding of how native, threatened and endangered, and non-native species may affect overall biodiversity. Recommendations are included regarding next steps for refining the each species list and potential initiation of long-term monitoring of the biodiversity in EVER for each taxonomic group. Additional taxonomic groups will be addressed in separate reports as the information is collected and vetted as appropriate.

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For more information on how the National Park Service views biodiversity visit:
http://nature.nps.gov/biology/biodiversity/
For online species lists visit NPSpecies:
https://irma.nps.gov/NPSpecies/