Recommended Guidelines for Adoption and Implementation of the NERRS Comprehensive Habitat and Land Use Classification System

Companion Document to:

"A Recommendation for a Comprehensive Habitat and Land Use Classification System for the National Estuarine Research Reserve System (NERRS)"

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(*ACE Basin, Apalachicola, Hudson River, Elkhorn Slough, North Carolina, San Francisco Bay, South Slough, and Tijuana River)

Introduction

This Implementation Plan was developed as a complement to the more comprehensive NERRS Classification System core document, and should be used specifically in that context. The primary objective of the Implementation Plan is to provide Reserve System personnel with a brief, practical set of guidelines for successful and efficient adoption (and use) of the NERRS Habitat and Land Use Classification System.

Two of the clear goals of this overall process are to provide a common baseline for temporal studies, and simultaneously enable the Reserves to reach a common level of understanding about the use of spatial data and mapping techniques. Successful achievement of those goals requires the efficient integration of the recommended habitat mapping protocols with sufficient consistency across Reserves to enable a system-wide knowledge base to develop and mature.

The guidelines provided in this document are designed to accommodate the range of landscapes, habitats, source materials, and technical capacities that are inherent to each Reserve. However, it is recognized that due to the uniqueness of certain Reserves not all scenarios can be anticipated. To address those circumstances, the Habitat Mapping & Change Committee has provided some recommendations and references for assistance.

As with any technical work plan, there are certain requirements that need to be acknowledged and met before actual adoption of the procedures. In particular, the personnel resources, technical knowledge, and supporting infrastructure need to be provided and appropriately allocated before the adoption of the classification system can be considered a success. The approach detailed in this document assumes a certain level of understanding with regard to basic mapping techniques, landscape feature recognition, habitat structure, and the use and management of digital data resources.

This document provides a brief background, examines the requirements for adoption, and details the actual implementation process. The Implementation Plan is organized into a series of logical steps designed to “escort” the user through the process. In addition, there is a brief overview of the conceptual and technical aspects (more detail is found in the accompanying Classification System document) and consideration of special circumstances.

Conceptual Framework

The NERRS Classification Scheme has a five-level, nested hierarchical structure, and strict numeric attributes. Section IV of the comprehensive Classification System document contains substantial detail regarding the five levels within the scheme, and should be *thoroughly* reviewed before any attempt to implement the system. Basically the five levels* are:

Level 1: System
Level 2: Subsystem
Level 3: Class
Level 4: Subclass
Level 5: Descriptor
** See Figure 1 and Table 1 in Classification Scheme document for clarification.*

This Implementation Guide addresses the use of the Classification Scheme for Reserves transitioning from an existing land cover database, and for Reserves just initiating the process. Examples of both scenarios are provided below, with accompanying implementation guidelines.

Fundamentally the application of the Scheme is a database development exercise. Although the same process could be undertaken using hardcopy maps, the ease and accessibility afforded by modern digital GIS/mapping software applications makes them a natural choice for executing the effort. The successful adoption and integration of this Classification Scheme is dependent upon a basic understanding of digital database management, cartographic principles, and ecology.

Each Reserve within the System will be responsible for characterizing and mapping the habitats within reserve boundary, and additionally be responsible for mapping (or acquiring) and maintaining (at a coarser level) the landscape features of the surrounding watershed. The resulting maps will be stored in digital format, enabling easy access, updates, and analysis in a geographic information system (GIS) environment. Ultimately, these data are expected to help populate the Centralized Data Management Office (CDMO) database.

The actual implementation is fairly elementary, though the process should be undertaken with appropriate diligence in order to yield the most accurate information. Adopting, and then following a strict protocol, which may vary somewhat between Reserves, is crucial to successful integration with existing activities and responsibilities. A series of key considerations is presented in an effort to provide a basic understanding of the implementation requirements.

Key Considerations

- There are two basic working scales; watershed level and reserve level. Each Reserve should develop an approach that is appropriate and feasible for their respective sites. If, for example, there is existing land cover data (e.g., C-CAP) for the surrounding watershed then this information should be acquired to avoid primary data collection and mapping. Such data can also be used as an independent source when compared with the more detailed mapping that will result from the NERRS Classification Scheme.

- While the process is, in essence, rather simple the overall effort itself is *not* insignificant. Reserves should be prepared to dedicate substantial staff time, or other resources to developing (and maintaining) their map database. However, once the initial mapping has been completed the process of updating the maps will require fewer resources – although the maintenance of the data should not be considered any less important. To facilitate temporal analysis (i.e., change detection) accurate data must be maintained.

- Reserve Managers and Research Coordinators should seriously consider designating one or more staff members/researchers/Fellows to undertake this process. Due to the systematic nature of the mapping exercise, the HM&C Committee strongly recommends personnel consistency during the database development.

- It should be understood that Reserves can characterize the landscape as precisely as possible/desired, within their respective data source constraints. However, each Reserve should at a minimum be able to characterize the relevant landscape features down to at least Class (Level 3), and preferably to Subclass (Level 4).

- The HM&C Committee suggests that each Reserve begin by mapping a small section of their site in order to become familiar with the process. Then, as appropriate personnel are trained the landscape characterization can be expanded to cover the remainder of the Reserve.

- Acquiring C-CAP data for the surrounding watershed first is strongly recommended. This process can serve as a training tool/exercise while providing important regional-level data. Basically, this level of mapping would use a moderate-resolution data source (e.g., Landsat imagery) in order to characterize the adjacent landscape.

- Besides *thoroughly* reading the accompanying NERRS Classification Scheme document it is strongly recommended that the responsible Reserve personnel familiarize themselves with the three underlying classification schemes that the NERRS Classification Scheme is based on (e.g., Anderson *et al.,* 1976; Cowardin *et al,* 1979*;* and Dobson *et al.*, 1995). A greater understanding of these references will be invaluable in developing confidence in using a hierarchical classification system.

- There are eight Reserves piloting the NERRS Classification Scheme, and communication among those sites and with the HM&C Committee is strongly encouraged. To the extent possible, the HM&C Committee will provide guidance and assistance to the pilot Reserves (i.e., ACE Basin, Apalachicola, Hudson River, Elkhorn Slough, North Carolina, San Francisco Bay, South Slough, and Tijuana River).

- It is expected that each of the pilot Reserves, and eventually all Reserves, will document the challenges and problems associated with the implementation process and provide these comments to the HM&C Committee in an effort to improve the overall process.

Basic Steps

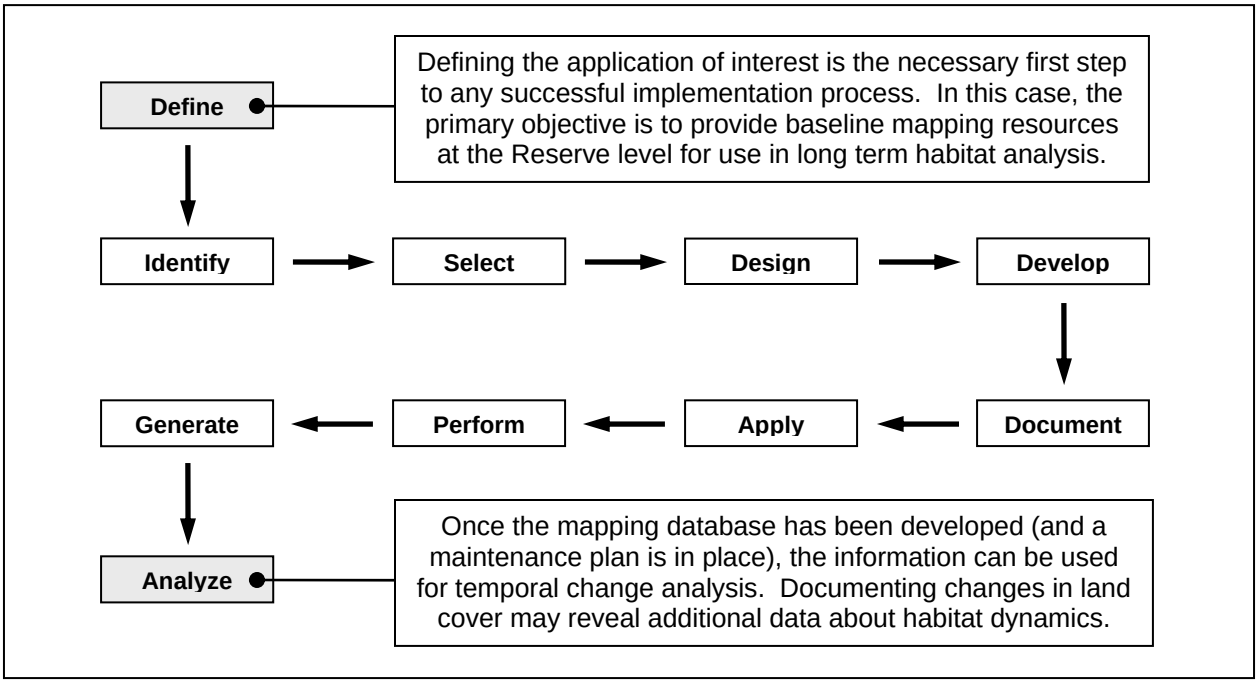
Assuming a decision to formally adopt the NERRS Classification Scheme, there are really two levels of "implementation". One is general in nature and addresses the basic issues of integrating any new technology or activity with existing responsibilities of an organization. The other aspect of this implementation deals directly with how to understand and use the NERRS Classification Scheme for its intended purposes. While not dismissing the former, the bulk of this document will focus on the latter aspect, with particular attention given to the preliminary requirements for implementation (i.e., planning), and use of the hierarchical system.

Each Reserve will, of course, have specific circumstances that influence the implementation process, including availability of resources, existing technical knowledge, type of source materials, and size of the site. However, there are some basic steps that will be common to all Reserves, and should be understood and followed to the greatest extent possible. A list of these common steps, that permit analysis, is provided below (also see **Figure1** and **Table 1**).

- Identify and compile existing map resources and/or habitat description materials
    - This step should have been completed as part of the HM&C inventory
- Select an appropriate scale for Reserve-level habitat mapping
    - This working scale should consider overall Reserve size, and key habitats
- Design *and document* the GIS database structure
    - This step is critical to proper data management and deserves special attention
- Develop a flow diagram for the implementation process
    - This serves as a checklist and should include the identification of data sources
- Document key "areas of interest" and habitats within the Reserve
    - This will enable change detection and the use of fine-level descriptors/modifiers
- Apply landscape unit codes accordingly
    - This step makes use of the hierarchical system levels
- Perform a standard map accuracy assessment process
    - This will help to quantify the level of accuracy for the resulting map products
- Generate metadata for the mapping database
    - This is an important step in properly documenting the entire process

If there are items on the list that you are unfamiliar with, or have questions about, it is strongly recommended that you communicate with the HM&C Committee before continuing with the process. A solid understanding of these steps is requisite to successful implementation of the Classification Scheme, and all efforts should be made to ensure clarification in advance.

Figure 1: Flow Diagram of General Implementation Process



In addition to the process flow depicted in **Figure 1** (above), it is helpful to understand how the format of the data being developed changes, and what environment is being used to manage or convert those data into information. **Table 1** provides a basic overview of these aspects.

Table 1: General Implementation Steps and Corresponding Data Format/Environment

Process Step	Data Format / Environment
Define the Application of Interest	At this stage there are no data, but the conceptual design would typically come in the form of a flow diagram or outline.
Identify Existing Information	Data formats will vary from hard copy maps to existing digital files. The working environment would ideally be a desktop GIS.
Select Appropriate Map Scale	The scale of the mapping project will be dictated by the application and available data. Compiled data should be in GIS format.
Design/Document GIS Database	The mapping database design should be formalized using a series of GIS tables and features. A clear design should be documented.
Develop Process Flow Diagram	A flow diagram should be developed using basic graphics and text. This will serve as a template for the implementation process.
Document Key Habitats/Species	Key areas within the Reserve should be mapped using spatial data functions. Extra information can be stored in tabular form.
Apply Classification Codes	The process of applying classification codes to defined land units should be completed in a GIS environment using tabular functions.
Perform Accuracy Assessment	This step combines *in situ* observation with statistical analysis. Data should be in printed and digital format, respectively.
Generate Metadata Files	Metadata files should be created using an FGDC-compliant format that will permit upload to/retrieval from an NSDI Clearinghouse.
Analyze Resulting Data	Analysis can take place in a variety of environments, including GIS and statistical applications, with appropriate analyst input.

Using the Hierarchical Classification System

A key aspect to recall when characterizing a given portion of the landscape (for mapping purposes) is that there are different levels of detail. This demands the hierarchical structure that defines the classification system architecture. This "nested" design permits a range of descriptors that can then be applied for use in different analytical circumstances.

The first step in using the classification system is to become familiar with the basic elements within the hierarchy (both the levels, and the content). In addition, a solid working knowledge of the landscape features within your Reserve is requisite. One method of combining these two requirements is to simply read through the entire classification system and highlight all of the systems, classes, etc. that are represented at your Reserve. This will provide you with a master working list of numeric values that can be used to populate the database. This list can also serve as a quick reference for noting the dominant and unique habitats within the Reserve.

Next, assuming you have already compiled the existing map/habitat description resources, begin by establishing a base map file in GIS format. The relational database structure will permit the addition of both spatially-defined features and tabular data in digital format. It is suggested that you begin by using the most comprehensive, accurate, and current baseline files that are available. If there are no existing digital map resources, then it will be necessary to obtain either a background image, or to scan (i.e., digitize) an existing hard copy map.

Once your base map has been identified, begin to partition the land cover and habitat features within the Reserve into appropriate polygons or landscape units. This should be accomplished by the identifying key habitats within the Reserve and combining any existing (verified/reliable) map resources *with* the working knowledge of the Reserve staff. This is an important step in the overall process and should be conducted by a group with varying knowledge and expertise. Remember: you are developing a *management-level* resource that will be used for broad-to-medium scale habitat change analysis (and/or educational purposes), so do not attempt to focus at the individual plant level.

Then simply examine the classification system (as provided) and select the appropriate Habitat type(s). For example, you might select "Marine Habitat" (code "1000") at the System Level. This value would then be placed in the appropriate field of the digital database. Then this step should be repeated for each subsequent landscape unit of interest. A separate field should be provided for an inclusive (concatenated) habitat characterization value. For example, such a value might be "1243", representing a Marine/Intertidal/Unconsolidated Shore/Sand habitat.

NOTE: It is **strongly recommended** that the GIS database design include enough fields to accommodate all of the five basic classification levels (i.e., system, subsystem, class, subclass, and descriptor), *and* also include additional fields for a concatenated value, modifiers, notes, and/or hyperlinks to further information. See more details in Database Design section, below.

Again, it would be best to concentrate on just a portion of the Reserve (ideally one that is well-known to those conducting the classification) before attempting a Reserve-wide mapping exercise. This will permit you to learn the basic process first, before committing to the more comprehensive effort. **Figures 2 and 3** illustrate the basic mapping process using an aerial photograph as the base resource.

Figure 2: Example Reserve Boundary with Underlying False Color Infrared Aerial Photograph

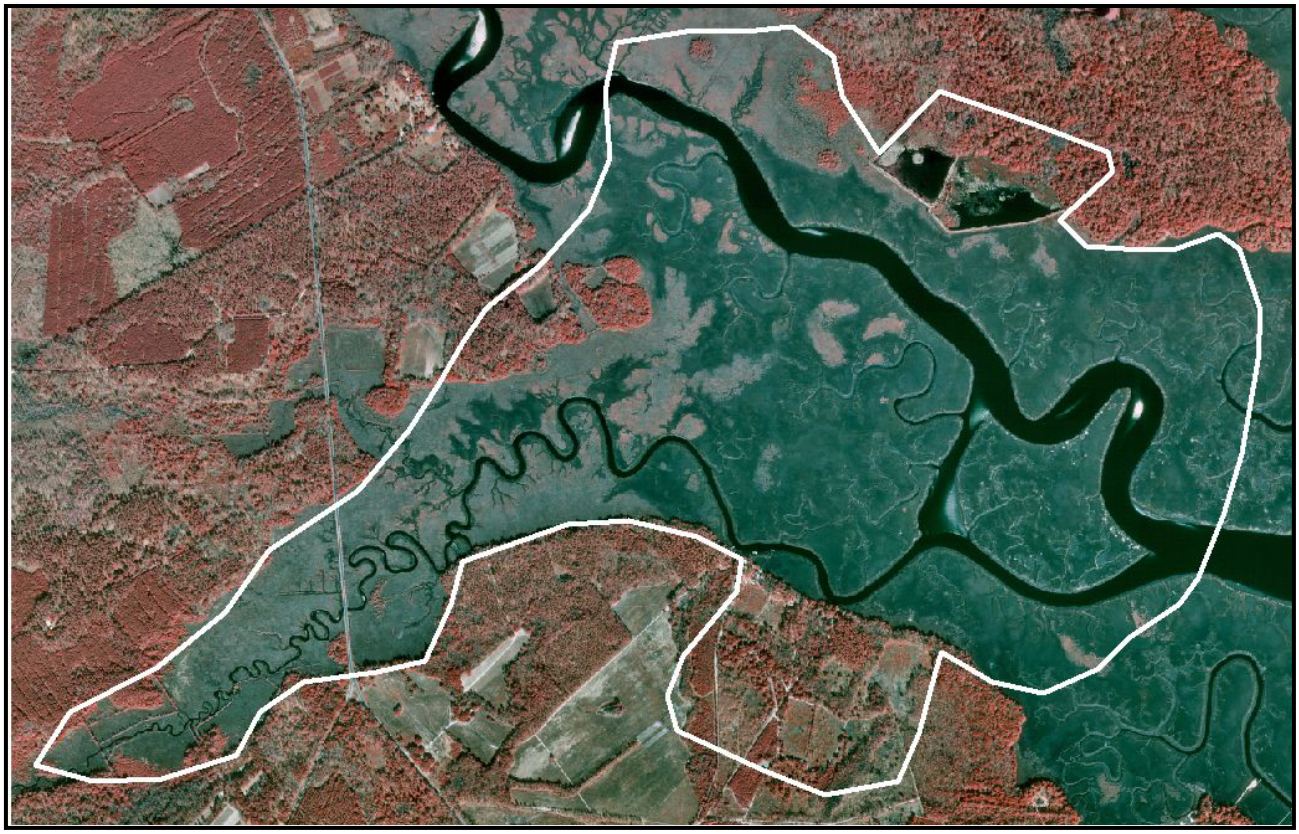


Figure 2 represents an example Reserve boundary, with a false-color infrared aerial photograph as the underlying data set. This is simply an example and does not represent all of the possible combinations or data sources that could be used to develop the mapping products. Other data sources might include existing GIS data layers, classified (i.e., categorized) satellite imagery, or thematic maps that have been scanned from hard copy format.

Figure 3: Example Land Cover Features for Classification within a Reserve Boundary and Associated Relational Database

Figure 3 depicts the relationship between the spatial features in the map and the tabular record attributes associated with these features. The combination of these two elements comprises the relational database structure that is inherent to any GIS. Data can be accessed or updated through either a spatial (feature) or tabular (record) query. Polygons should be used to define the habitat boundaries, and a 0.25 acre patch should be used as a minimal mapping unit.

sampledb.dbf

Sys_Num	Sys_Nam	SubSys_Num	SubSys_Nam	Cls_Num	Cls_Nam	SubCls_Num	SubCls_Nam	Dsc_Num	Dsc_Nam	Mod1	Mod2
1000	Marine	1200	Intertidal	1240	Unconsolidated	1243	Sand	0.00		Regularly Flooded	Restricted Use Beach
0		0		0		0		0.00			
1000	Marine	1200	Intertidal	1240	Unconsolidated	1240	Unknown	0.00			
0		0		0		0		0.00			
0		0		0		0		0.00			

Figure 3 shows an example of the recommended database design – one that incorporates the key classification levels as a series of fields. Each of the five levels is represented in both numeric and nominal form. For example, the System (Level 1) is comprised by the first two fields (i.e., Sys_Num and Sys_Nom), allowing the analyst to document a feature through both numeric values and a more descriptive (nominal) label. Also, several fields are provided for Modifiers so additional information can be provided for a given habitat feature. This basic architecture (with fields running across and records down) is typical of most desktop GIS applications. Other fields can be added as needed (e.g., perimeter, feature ID, map index number, date, etc.) and can to serve as a link to other relevant database files. In the event that a Classification level is not reached then the most detailed level should be entered for the remaining levels to avoid database gaps.

Basic Database Design Considerations

It is strongly recommended that each Reserve include (at a minimum) the standard database fields (that correspond to the Classification Scheme) shown in **Table 2**.

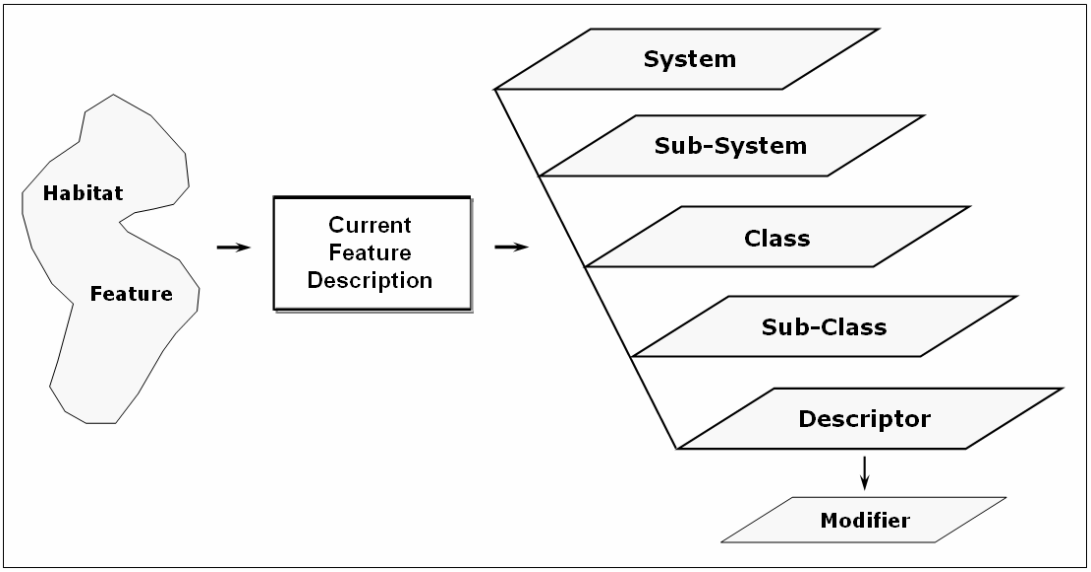
Table 2: Recommended Standard Database Fields

Parameter	Field Name	Description
System (Numeric)	Sys_Num	Level 1 classification using numeric codes.
System (Nominal)	Sys_Nom	Level 1 classification using nominal description.
Subsystem (Numeric)	SubSys_Num	Level 2 classification using numeric codes.
Subsystem (Nominal)	SubSys_Nom	Level 2 classification using nominal description.
Class (Numeric)	Cls_Num	Level 3 classification using numeric codes.
Class (Nominal)	Cls_Nom	Level 3 classification using nominal description.
Subclass (Numeric)	SubCls_Num	Level 4 classification using numeric codes.
Subclass (Nominal)	SubCls_Nom	Level 4 classification using nominal description.
Descriptor (Numeric)	Dsc_Num	Level 5 classification using numeric codes.
Descriptor (Nominal)	Dsc_Nom	Level 5 classification using nominal description.
Feature Area	Area	Describes, in appropriate units, the area of the feature.

Conversion of an Existing Land Cover Database

While it is certainly reasonable to maintain an existing database, one of the primary objectives of this effort is to create a common resource within the Reserve System. Therefore, if the existing data are used and maintained there should also be a clear plan for converting that information into the new Scheme. This is easily accomplished by linking the old and new databases through a common field of attributes, or simply revising the current feature description to fit within the newly adopted NERRS Classification Scheme as shown in **Figure 4**.

Figure 4: Diagram of Conversion to NERRS Classification Scheme



Adding Modifiers

- Modifiers are technically outside of the classification hierarchy and are designed to provide a greater degree of descriptive/analytical detail for an area of land.

- Modifiers may also help facilitate conversion from one classification system to another by creating a common field/attribute.

- Modifiers can be associated with physical, management, or cultural processes or activities (see Appendix 2 of the Classification System document).

- These attributes should be added via a new column(s) in the database and would generally take the form of a text string (e.g., "impounded area").

- More details are provided in Section IV of the Classification System document.

Key Technical Requirements

- GIS capacity (both infrastructure and personnel)
- Base map source(s) for database foundation
- Training time allocated for responsible personnel
- Strong working knowledge of habitats within the Reserve
- Understanding of basic cartographic principles, including:
    - map scale/projections; geo-rectification; accuracy assessment
- Understanding of metadata development and data management

Scale of the Mapping

Each Reserve should carefully consider the appropriate scale at which to map their resources. Basically, there are two areas that should be considered: (1) the surrounding watershed, and (2) the Reserve boundary. Characterizing the landscape features at these two different levels will permit analysis at general and specific scales.

Anomalies should be included in the master list of habitats, but may not always show up as discrete landscape areas on the maps due to the level of the mapping. One way to ensure that such anomalies (e.g., a small area of invasive vegetation) are maintained is to add them as modifiers so that their presence is documented.

A general rule is to characterize the habitat to the level/extent that is possible without compromising accuracy. In essence, if an area of homogenous habitat can be defined down to the Subclass level then the map should reflect that level of detail. If an area can only be defined at the System level then fill the remaining classification fields with the most detailed level that was reached. The basic idea is to leave no voids in the map – creating a continuous database.

Additional Considerations

Overall, the adoption and implementation of this Classification System should be relatively easy. However, there are certain aspects of the process that may be problematic, or require additional knowledge, skills, or resources. In an effort to avoid these challenges, to the greatest extent possible, the HM&C Committee has also provided some recommendations (below) designed to minimize complications that may arise.

1. Legacy Issues:
   - Archiving of the database resources should be pre-planned
   - Metadata should be developed in concert with the database

2. Update Interval:
   - Maintenance plan for the database is requisite
   - Imagery acquisition (if any) needs to be pre-planned

3. Technical Staff Requirements:
   - GIS/RS/GPS/Photo interpretation
   - Field verification mapping skills

4. Adoption/Implementation Schedule:
   - Implementation plan should be well-established
   - Stages of implementation should be understood and followed

5. Metadata Development:
   - FGDC format compliance is strongly recommended
   - Existing capacity for metadata development should be assessed

6. SWMP/CDMO Integration:
   - Integration with SWMP and Bio-Monitoring Program
   - Transfer of data to CDMO (plan forthcoming)

7. Challenges to Avoid:
   - The idea is to provide a base map inventory, don't try to map every square foot
   - Work at a practical, realistic management-driven scale
   - Recognize the financial and technical requirements for detailed mapping

8. Identifying Assistance:
   - Try to identify strategic partners within your region (other Reserves, or universities)
   - Trouble in describing a specific area of the landscape should resolved through examination of the source classification systems (i.e., C-CAP; Cowardin, *et al.*)

9. Providing Feedback:
   - Send to the HM&C Committee:
     - Efficient techniques that were learned
     - Challenges to implementation
     - Costs and technical requirements

Summary of Recommendations

- When generating habitat boundaries keep in mind that you are defining homogenous *areas*, and not focusing on isolated *point* features.

- If constrained by costs, we recommend the use of false color infrared (CIR) imagery acquired during the wet season image acquisition, and ideally at low tidal stage. Imagery should be geo-rectified to a common map reference layer.

- The HM&C Committee will assist Reserves with C-CAP data acquisition for use in regional watershed level analysis.

- Select (and then maintain the use of) a specific map projection, datum, and units for your database. Check with your state partner to ensure local compatibility.

- We suggest a mapping scale between 1:24,000 and 1:3,000 if the source data are based on aerial photography. This may, of course, vary depending upon the overall size of your Reserve, available resources, and/or the extent of the area of interest.

- If using "heads-up" (i.e., on-screen) digitizing techniques maintain a consistent on-screen viewing scale (e.g., 1:3000 to 1:5:000) and minimum mapping unit (e.g., 0.25 acre) to ensure database integrity.

- Develop the baseline data first, then focus more intensely on smaller areas if greater interest for future image/data acquisitions. Imagery should be collected at 5-year intervals (at a minimum).

- Plan on 4-6 months of preparation for an image acquisition. Contact HM&C Committee for more details concerning specific acquisition parameters. Also, see Table 3, below.

- Figure 5 (below) provides a basic overview of the process flow required to develop a mapping database using the NERRS Classification Scheme. Each Reserve should develop a similar flow diagram – modified as needed based on available resources and source data.

- There is a System-wide effort to generate baseline data for each reserve that will enable future change detection, but larger reserves (or reserves with limited resources) may have to select specific habitats or smaller areas of interest for detailed analysis

- Appendix A provides some additional references and resources. Also see Reference Section of overall Classification Scheme document.

- Field verification surveys (see Appendices B and C) should be used to assist in quantifying the level of map accuracy and should focus on the dominant cover types.

- Recognize that with increases in detail (i.e., finer spatial resolution) the costs of the map database will also increase, and most likely at an exponential rate (not a linear one).

- We recommend using a minimum mapping unit of approximately 0.25 acres (0.1 ha) for habitat features.

Figure 5: Basic Process Flow for Classification Database Development and Use

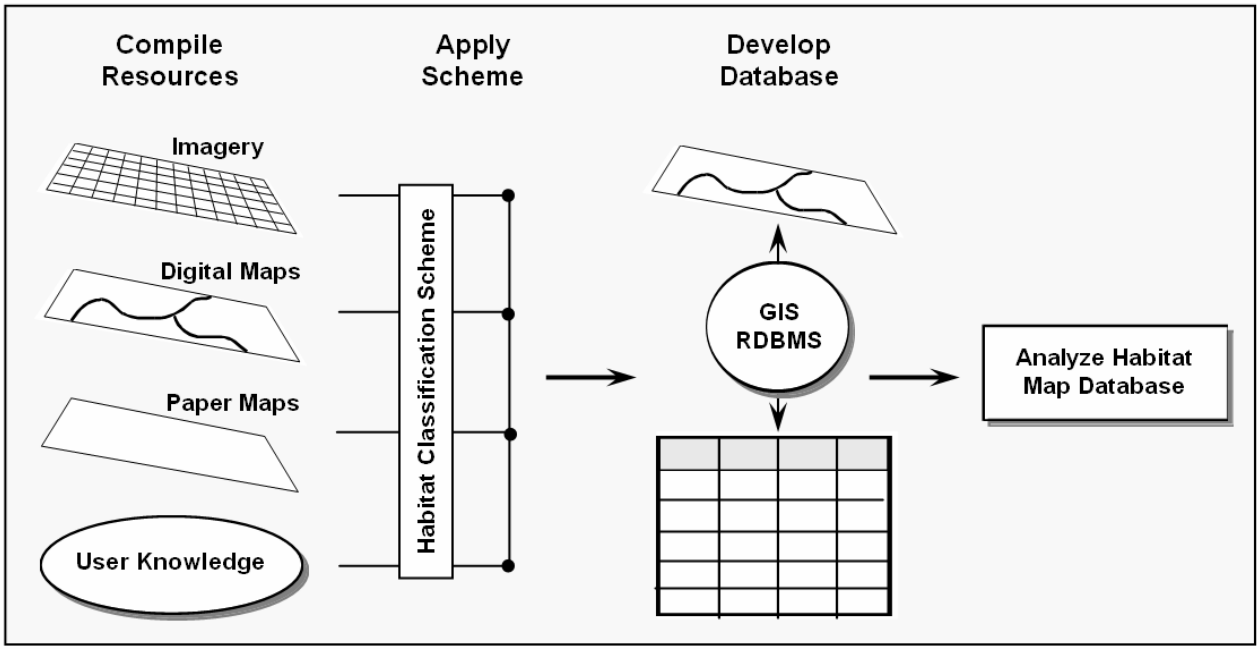


Table 3: Summary of Basic Foundation Data Types and Sources

Type of Data	Description	Sources*
Satellite Imagery	Proprietary image formats captured through orbiting cameras or scanners	Acquired through public agencies or private sector contractors
Aerial Photography (B&W)	Custom photography acquired to maximize tonal differences and land/water	Generally acquired through private contractor purchase
Aerial Photography (Color)	Custom photography acquired to mimic true-color characteristics	Generally acquired through private contractor purchase
Aerial Photography (CIR)	Custom photography acquired to maximize vegetation differences	Generally acquired through private contractor purchase
NOAA C-CAP Database	Regional-level Coastal Change Analysis Program data based on Landsat data	Acquired through NOAA Coastal Services Center
Local GIS Database	Digital maps (and attributes) describing both natural and created landscape features	Acquired through public agencies or already exists at Reserve or with state partner
Existing Hard Copy Data	Paper maps or printed materials describing habitat features within a Reserve	Acquired through public agencies or already exists at Reserve or with state partner
***** *Contact HM&C Committee for additional information*		

Appendix A: References and Resources

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Congalton, R. G. and R. A. Mead. 1983. A Quantitative Method to Test for Consistency and Correctness in Photointerpretation. *Photogrammetric Engineering and Remote Sensing*, 49:69-74.

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Jensen, J.R. 2004. Introductory Digital Image Processing: A Remote Sensing Perspective (Third Edition). Prentice-Hall, Inc., Upper Saddle River, NJ, 544 pp.

Kutcher, T.E., Garfield, N.H., and Raposa, K.B. 2005. A Recommendation for a Comprehensive Habitat and Land Use Classification System for the National Estuarine Research Reserve System. Estuarine Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD, 26 pp.

Wenner, E.L. 2002. The National Estuarine Research Reserve's System-wide Monitoring Program: A Scientific Framework and Plan for Detection of Short-term Variability and Long-term Change in Estuaries and Coastal Habitats of the United States. NERRS Guiding Document (unpublished report to NOAA/NOS/OCRM), Silver Spring, MD, 48 pp.

Appendix B: Example Field Data Collection Form

HABITAT INVENTORY DATA SHEET

Polygon: _____ Code: _____ Date: _____

Investigator: _____ Area: _____

CLASSIFICATION HIERARCHY

System: _____

Subsystem: _____

Class: _____

Subclass: _____

Descriptor: _____

MODIFIERS (Refer to Appendix 2 for modifiers within each type below)

1. Dominant Species_____
2. Invasive Species _____ Cover Class_____
3. Water Regime_____
4. Cultural _____
5. Salinity _____
6. Managed _____
7. _____
8. _____

ASSOCIATED SPECIES

_____

_____

_____

ADDITIONAL OBSERVATIONS / SITE SKETCH

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Appendix C: Example Field Data Verification Form

HABITAT VERIFICATION DATA SHEET

Polygon: _____ Code: _____ Date: _____

Investigator: _____ Area: _____

NOTES

_____

_____

_____

	OBSERVED FEATURE CODES					
SITE ID	SYSTEM	SUBSYSTEM	CLASS	SUBCLASS	DESCRIPTOR	GPS (Y/N)

THIS DOCUMENT IS DESIGNED TO RECORD IN SITU INFORMATION IN SUPPORT OF A FIELD VALIDATION SURVEY (PART OF AN ACCURACY ASSESSMENT FOR THEMATIC MAPPING EFFORTS). OBSERVED DATA ARE COMPARED WITH PREDICTED VALUES TO YIELD MAP ACCURACY LEVELS. GENERALLY THIS DOCUMENT IS ACCOMPANIED BY A MAP FOR NAVIGATION AND SAMPLE POINT/AREA VERIFICATION IN THE DESIGNATED SURVEY AREA.

Appendix D: NERRS Habitat Mapping & Change (HM&C) Technical Committee Members

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Pilot Reserves:

ACE Basin (SC)
Apalachicola (FL)
Hudson River (NY)
Elkhorn Slough (CA)
North Carolina (NC)
San Francisco Bay (CA)
South Slough (OR)
Tijuana River (CA)