Development of a Comprehensive State Monitoring and Assessment Program for Wetlands in Massachusetts

Appendix U

Standard Operating Procedures: Photo Interpretation and Data Development for Coastal Human Activity Disturbance Metrics

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Standard Operating Procedures: Photo Interpretation and Data Development for Coastal Human Activity Disturbance Metrics

Purpose

The Conservation Assessment and Prioritization System (CAPS) is an ecosystem-based (coarse-filter) approach for assessing the ecological integrity of lands and waters and subsequently identifying and prioritizing land for habitat and biodiversity conservation. CAPS is a computer software program and an approach to prioritizing land for conservation based on the assessment of ecological integrity for various ecological communities (e.g. forest, shrub swamp, headwater stream, salt marsh) within an area.

CAPS includes a number of metrics – each representing a different stressor on the landscape (e.g. habitat loss, buffer zone impacts, road traffic intensity, non-native invasive plants) and 2 resiliency metrics (i.e. connectedness and similarity), developed using GIS data and expert teams. The model combines the various metrics to produce an overall value (i.e. Index of Ecological Integrity (IEI)) or it can produce values for each metric separately to gain a greater understanding of which stressors have the greatest impact depending on the scenario.

As part of this project the team is working to develop new CAPS metrics that will represent stressors that specifically affect the coastal environment so that the CAPS model will represent the entire Commonwealth of Massachusetts. Human activity associated with recreational use of coastal ecosystems – including pedestrian traffic, off road vehicle (ORV) use, and boat traffic – is a stressor that affects the ecological integrity of coastal ecological communities.

Although recreational use of coastal beaches do not generally result in long-term alteration of physical characteristics of beach systems, heavy human use of beaches by pedestrians and ORVs cause disturbances that reduce wildlife use of those areas for nesting and foraging. Areas subjected to heavy recreational use consistently over time (e.g. public recreational beaches) are considered to have reduced ecological integrity compared to similar areas that are not subjected to such heavy human use.

Boat traffic in near shore areas of the coastal zone can cause disturbance due to the motion of the boats and noise and wakes produced by those boats. Noise and motion impacts have the potential to affect all coastal ecological communities. Boat wakes are a concern primarily for coastal communities that otherwise form in areas sheltered from ocean waves.

Coastal metrics under development as part of this SOP include:

- Beach pedestrian traffic. This has two components. One is associated with recreational beaches where access is strongly affected by car or other transportation access. The other is related to foot traffic from nearby residential areas.

- ORV use. This metric focuses on coastal beaches that receive heavy use by ORVs including well-established areas of congregation as well as heavily traveled corridors on coastal beaches, where such use is likely to continue into the foreseeable future.
- Boat traffic. The focus of this metric is the impact related to motion disturbance, noise and boat wakes (rather than more local impacts such as propeller wash or discharges of pollutants).

The purpose of this project is to develop data, based on photo-interpretation, to be used in implementing these metrics. Specifically:

- Parking lots serving recreational beaches
- Areas of coastal beach subject to heavy ORV use
- Classification of near-shore environments based on levels of boat traffic

These data will be developed comprehensively for the entire coastal zone of Massachusetts and will be used for the development of the three CAPS metrics described above. Once these metrics are included in CAPS they will be used to assess the overall ecological integrity of coastal shoreline areas. Results of CAPS evaluations (IEI scores) will be used by MassDEP, CZM and other agencies to inform decision-making and set priorities for conservation. There is no intention to use these data for any other purposes.

Definitions

For the purposes of this mapping project we have adopted the following definitions.

Beach Parking Lot – A parking lot or other parking area within 800 m of a recreational beach that provides parking for people accessing that beach.

Coastal Beach – An ecological community used by CAPS and mapped by MassDEP. MassDEP mapping is based on the definition of coastal beach in the Massachusetts Wetlands Protection Act and implementing regulations except that tidal flats (a subset of coastal beaches as defined in the regulations) are mapped separately. As used in this SOP "coastal beach" does not include tidal flats.

ORV Beach – An area of coastal beach that is heavily and regularly used as an area of congregation for ORV users or that is heavily and regularly used by ORVs to move between areas but not for parking, where such use is likely to continue into the foreseeable future.

Recreational Beach –Public or Semi-public (private but open to the public) beach as defined by the BEACH Act and mapped the MA Department of Public Health.

Photo-interpretation and Classification

Beach Parking Lots

The primary source for photo-interpretation will be the most recent statewide orthophotos dated 2008 and 2009. However, photo-interpreters will also consult the black and white imagery (1993-95), the 2001 color orthophotos, the 2005 color orthophotos, and the 2003 and 2008 oblique angle aerial photos (Pictometry) as needed. The primary focus of this project is to accurately capture all parking areas serving recreational beaches. The photo-interpreter will use whatever imagery or scale is necessary to achieve that goal.

Procedure

1. The MA Department of Public Health Marine Beaches data layer available from MassGIS (http://www.mass.gov/mgis/marinebeaches.htm) will be the source for identification of recreational beaches.
2. For each recreational beach the photo-interpreter will identify all parking areas within 800 m that appear to be providing parking for people accessing that beach (e.g. not associated with a business or other purpose). The minimum mapping unit will be 700 m^2.
3. Photo-interpreter will delineate all beach parking lots as polygons in a "Beach Parking Lot" GIS data layer.
4. Based on expert opinion from MassDEP and CZM personnel, and beach managers add additional parking areas that were previously excluded because they either were > 800m away from a recreational beach or appeared to be associated with a business or other purpose.
5. Where appropriate delineated beach parking lots will be removed from the GIS data layer if expert opinion indicates that they do not serve as parking areas for recreational beaches.

Key Personnel

Michael McHugh, MassDEP, Overall coordination; provide training of primary photo-interpreter; some photo-interpretation; perform quality assurance checks to ensure compliance with these mapping standards; solicit expert opinion from MassDEP and beach managers

Bradley Compton, UMass, Review data for compliance with CAPS standards.

Marc Carullo, CZM, Solicit expert opinion from MA CZM and beach managers.

Nathalie Regis, UMass, Primary photo-interpreter.

Quality assurance/Quality control (QA/QC)

Photointerpretation and digitization will be conducted by the primary photointerpreter, Nathalie Regis, who has previous experience in mapping anthropogenic coastal features. Mike McHugh will do Quality Assurance/Quality Control checks that will consist of comparing linework with imagery. All linework will be reviewed and 10 percent will be carefully examined by Mike

McHugh to determine whether it meets QA/QC objectives. Brad Compton will review linework after the first day of digitizing, throughout as requested, and at end of project to ensure its usability for CAPS metric development and modeling.

Data Quality Objectives

Parameter	Units	MDL	RDL	Expected Range	Accuracy (+/-)	Precision
Beach Parking Lots	Parking Area polygons	NA	NA	Minimum mapping unit = 700 m^2	90% accuracy in identifying and classifying features	95% of linework will be within 15 m of feature in the image based on 10% QA/QC review

ORV Beaches

The primary sources of information to be used include:

- The most recent statewide orthophotos dated 2008 & 2009
- MassDEP Wetlands data layer
- Information from beach managers and other experts on the location and geographic extent of beaches that are heavily used by ORVs, where such use is likely to continue into the foreseeable future.

Procedure

1. Identify appropriate beach managers and experts within MassDEP and MA CZM to provide information
2. Solicit information about the location and geographic extent of coastal beaches that are heavily used by ORVs from beach managers and experts identified in #1 above
3. Using a base map of DEP Wetlands data overlaid onto ortho-photos use information provided by experts to delineate ORV beaches as polygons in an "ORV Beaches" GIS data layer. The minimum mapping unit will be 700 m^2.

Key Personnel

Marc Carullo, CZM, Overall coordination; solicit expert opinion from MassDEP, MA CZM and beach managers

Michael McHugh, MassDEP, Training of primary photo-interpreter; some photo-interpretation; perform quality assurance checks to ensure compliance with these mapping standards

Bradley Compton, UMass, Review data for compliance with CAPS standards.

Nathalie Regis, UMass, Primary photo-interpreter; assist in compiling information from beach managers and other experts

Quality assurance/Quality control (QA/QC)

Photo-interpretation and digitization will be conducted by the primary photointerpreter, Nathalie Regis, who has previous experience in mapping coastal features. Mike McHugh will do Quality Assurance/Quality Control checks that will consist of comparing linework with imagery and information provided by consulted experts. All linework will be reviewed and 10 percent will be carefully examined by Mike McHugh to determine whether it meets QA/QC objectives. Brad Compton will review linework after the first day of digitizing, throughout as requested, and at end of project to ensure its usability for CAPS metric development and modeling.

Data Quality Objectives

Parameter	Units	MDL	RDL	Expected Range	Accuracy (+/-)	Precision
ORV Beaches	ORV Beach polygons	NA	NA	Minimum mapping unit = 700 m^2	90% accuracy in identifying and classifying features	95% of linework will be within 15 m of feature in the image based on 10% QA/QC review

Boat Traffic

Data on boat traffic is not currently available that can be used by CAPS to model the impact of boat traffic on coastal shoreline ecosystems. We intend to use a variety of information to create a coarse data layer that characterizes coastal areas for boat traffic intensity. These will not be quantitative data but instead a qualitative assessment of relative boat traffic intensity.

Data sources will include:

NOAA Raster Navigational Charts (RNCs)

2008/2009 statewide ortho imagery

DEP Wetlands

CZM MORIS Layers:

- Office of Fishing and Boating Access sites (ramps)
- Mooring Fields
- Marinas

Other: 1993-95 black/white orthos, 2001 & 2005 orthos, Google Earth, Bing oblique angle, Pictometry; used on an as needed basis.

Procedure

The project area for this mapping project shall begin at the upper-most extent of either salt marsh or tide flat, whichever is further inland, and shall extend seaward 300m beyond salt marsh, tidal flat and coastal beach resource areas as mapping in the DEP Wetlands data layer. A 150m x 150m vector grid will be overlaid onto the project area. Larger grid cells were considered, but it was found that they fail to capture, and thus characterize, certain narrow yet significant features such as channels. Smaller grid cells were considered, but it was found that they are too time consuming to populate and the increased detail did not serve to better characterize the areas in question. A grid cell will be excluded from the study area if 100% of it is completely within upland and/or freshwater wetland areas (as defined by the DEP wetlands layer); i.e., a cell is not within open water, salt marsh, tidal flat or rocky intertidal shore. By reducing irrelevant cells we will reduce user error and improve computer performance during analysis.

Image analysts will create work areas within the project area, based on a given embayment, river, harbor, segment of shoreline, etc. The object is to create manageable work areas to evaluate, and prevent gaps in coverage. Starting at the upper most (inland) extent of the work area (within the project area), image analysts will note the presence of mapped channels, channel markers, mooring areas, marinas, boat ramps, presence and density of docks/piers, visual indicators of boat traffic on the imagery such as scour marks, moored boats, visible channels, unmapped (informal) boat ramps, and personal knowledge of boating activity in the area. Each cell will then be characterized for boat traffic intensity, based on the presence of the preceding. Cells will be characterized as:

None: There is no reasonable expectation the boats utilize the area with any frequency. Example: A cell that is 100% salt marsh, and contains no navigable creeks or channels.

Low: There is reasonable expectation that boats infrequently utilize the area, but they do so at a low level of intensity. Example: A cell that is mostly tide flat and is upstream of all marinas, ramps, and mooring areas.

Medium: There is reasonable expectation that boats frequently utilize the area Example: A cell that is 100% open water, the NOAA Chart indicates sufficient depth for boats to maneuver, and the cell is near or adjacent to a high traffic cell.

High: There is reasonable expectation that boats frequently utilize the area, and they do so at a high level of intensity. Example: A cell that contains a mooring area, a mapped channel, and is down stream from a marina and boat ramp.

Any cell that is 10% or less of coastal wetland (salt marsh, tide flat, or open water) will be dropped from consideration. Analysts will visually evaluate the remaining cells, and score each individual cell based on an assessment of all of the boating indicators (e.g. mapped channels, mooring areas, marinas) within the cell. The result will be an integer; 0=None, 1=Low, 2=Medium, 3=High. Once a given work area is completed it will be labeled complete and the

next work area shall be evaluated. This process will be continued until all areas along the Massachusetts coast are characterized.

Work Flow:

--Establish a work area.

--Start review landward, working seaward

--Note locations of ramps, docks, piers, mooring areas, channels etc.

--Characterize “high” traffic cells

--Characterize “medium” traffic cells

--Characterize cells with no boat traffic (“none”)

--All remaining cells default to “low” boat traffic.

--Visually review to ensure that project area contains no uncharacterized cells.

--Mark project area as completed.

--Establish new project area and repeat.

Data Management

The vector grid will be stored in the ESRI file geodatabase format. It will be divided into three sections, one for each analyst. This will allow the analysts to work independently. The sections will be merged into one final geodatabase upon completion of the classification work. CZM’s FTP server will be used to transfer data sources and completed grid sections to and from analysts. The final geodatabase will be transferred to UMass project staff, where it will be input into the CAPS model to run the boat traffic intensity metric.

Key Personnel

Michael McHugh, MassDEP. 20 years experience identifying and evaluating coastal resources throughout Massachusetts. 15 Years experience in off shore field work. Overall coordination; compilation of final data layer; image analyst.

James Sprague, MassDEP, 33 years experience identifying and evaluating coastal resources throughout Massachusetts. Former lobsterman. Avid small watercraft operator. Image analyst.

Marc Carullo, CZM, Coastal Resource Mapping Specialist GIS and Coastal Habitat Analyst with expertise in spatial (and non-spatial) data development, management, and analysis; image processing techniques and applications, and ecological field data collection, particularly in coastal ecosystems. Image Analyst.

Quality assurance/Quality control (QA/QC)

The focus of quality assurance is on consistency of scoring as opposed to the specific intensity classification accuracy of each individual cell. That consistency must be maintained as an individual analyst and among analysts. In order to ensure that consistency the analysts will characterize the cells in three separate study areas together. The analysts will then work independently. When 25% of the work load is completed each analyst will review the other's characterizations to insure uniformity and consistency in characterization between analysts. Of the remaining work load, 50% will undergo the same process.

QA/QC Process

Phase I. All three image analysts will work together and jointly classify cells for the first three work areas. Additional work areas will be jointly classified, if needed, to develop consistency among analysts' classifications.

Phase II: From the end of phase I up to 25% of the workload (25% of work areas). Image analysts will work separately to classify cells within work areas. Each cell will then be reviewed and independently classified by the other two analysts. Discrepancies will be resolved through discussion and consensus among the three analysts. The objective is for all three analysts to agree for 90% of cells evaluated in this phase of the work. Additional work areas (beyond the 25% of workload) will be evaluated in this way until the objective of 90% agreement has been achieved.

Phase III: Remainder of the workload after phase II. Image analysts will work separately to classify cells within work areas. Fifty percent of cells will be reviewed and independently classified by the other two analysts. Discrepancies will be resolved through discussion and consensus among the three analysts. If the objective of 90 % agreement is not met for the 50% checks then the process will revert back to phase II procedures until the 90% objective is met.

Data Quality Objectives

Parameter	Units	MDL	RDL	Expected Range	Accuracy (+/-)	Precision
Boat Traffic	Boat Traffic Intensity Classes	NA	NA	0-3	90% of cells accurately characterized*	90% agreement among all three analysts

* There is no way currently to assess the accuracy of this classification. However, our objective for accuracy is that should boat traffic data become available in a form that can be compared with our classification, no more that 10% of cells will fall within a range of overlap for our classes (e.g. cells classified as "high" with traffic volumes that overlap with those that were classified as "medium").