

## Oyster Mapping and Monitoring Resources in Florida

**Table 1.** Selected habitat classification schemes for oyster reefs

| Name  | Affiliation                                       | Region                  | Classification Scheme  | Reference                              |
|---|---|-------------------------|--|--|
| Florida Land Use and Cover Classification System (FLUCCS)                           | Florida Department of Transportation              | Florida                 | Wetlands <ul style="list-style-type: none"> <li>○ Non-vegetated</li> <li>● Oyster bars</li> </ul>  | FDOT 1999                              |
| System for Classification of Habitats in Estuarine and Marine Environments (SCHEME) | Florida Fish and Wildlife Conservation Commission | Florida                 | Reef/Hardbottom <ul style="list-style-type: none"> <li>○ Mollusk reef</li> <li>● Bivalve reefs</li> </ul>  | Madley et al. 2002                     |
| Guide to the Natural Communities of Florida   | Florida Natural Areas Inventory                   | Florida                 | Marine and estuarine <ul style="list-style-type: none"> <li>○ Mollusk reef</li> </ul>  | FNAI 2010                              |
| Florida Land Cover Classification System  | Florida Fish and Wildlife Conservation Commission | Florida                 | Estuarine <ul style="list-style-type: none"> <li>○ Intertidal</li> <li>● Oyster bar</li> </ul>   | Kawula 2009, 2014                      |
| Sarasota County Water Quality Planning Methods Manual for Field Mapping of Oysters  | Sarasota County                                   | Sarasota and Tampa Bays | Oyster habitat <ul style="list-style-type: none"> <li>○ Shell</li> <li>○ Scattered shell</li> <li>○ Oyster clumps</li> <li>○ Scattered oyster clumps</li> <li>○ Oyster reef</li> <li>○ Oyster clumps/reef</li> <li>○ Mangrove apron</li> <li>○ Mangrove root oysters</li> <li>○ Seawall</li> <li>○ Rip rap</li> <li>○ Pilings</li> <li>○ Floating docks</li> </ul>   | Meaux 2011                             |
| Classification of Wetlands and Deepwater Habitats of the United States              | U.S. Fish and Wildlife Service                    | National                | Estuarine <ul style="list-style-type: none"> <li>○ Subtidal <ul style="list-style-type: none"> <li>● Reef <ul style="list-style-type: none"> <li>▪ Mollusk</li> </ul> </li> </ul> </li> <li>○ Intertidal <ul style="list-style-type: none"> <li>● Reef <ul style="list-style-type: none"> <li>▪ Mollusk <ul style="list-style-type: none"> <li>● Regularly flooded</li> <li>● Irregularly flooded</li> </ul> </li> </ul> </li> </ul> </li> </ul> | Cowardin et al. 1979, FGDC 2013        |
| Coastal Change Analysis Program (C-CAP) Classification System                       | National Oceanic and Atmospheric Administration   | National                | Marine/Estuarine reef <ul style="list-style-type: none"> <li>○ Mollusk reef</li> </ul>   | Klemas et al. 1993, Dobson et al. 1995 |
| Coastal and Marine Ecological Classification Standard (CMECS)                       | Federal Geographic Data Committee                 | National                | Geoform origin: Biogenic <ul style="list-style-type: none"> <li>○ Geoform: Mollusk reef <ul style="list-style-type: none"> <li>● Fringing mollusk reef</li> <li>● Linear mollusk reef</li> <li>● Patch mollusk reef</li> <li>● Washed shell mound</li> </ul> </li> </ul>   | FGDC 2012                              |

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  | <p>Substrate: Biogenic</p> <ul style="list-style-type: none"><li>○ Shell substrate<ul style="list-style-type: none"><li>● Shell reef substrate<ul style="list-style-type: none"><li>▪ Oyster reef substrate</li></ul></li><li>● Shell rubble<ul style="list-style-type: none"><li>▪ Oyster rubble</li></ul></li><li>● Shell hash<ul style="list-style-type: none"><li>▪ Oyster hash</li></ul></li></ul></li></ul> <p>Biotic setting: Benthic/attached biota</p> <ul style="list-style-type: none"><li>○ Reef biota<ul style="list-style-type: none"><li>● Mollusk reef biota<ul style="list-style-type: none"><li>▪ Oyster reef (<i>Crassostrea</i>, <i>Ostrea</i>)</li></ul></li></ul></li><li>○ Faunal bed<ul style="list-style-type: none"><li>● Attached fauna<ul style="list-style-type: none"><li>▪ Attached oysters (<i>Crassostrea</i>, <i>Ostrea</i>)</li></ul></li><li>● Soft sediment fauna<ul style="list-style-type: none"><li>▪ Oyster bed (<i>Crassostrea</i>, <i>Ostrea</i>)</li></ul></li></ul></li></ul> |  |
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**Table 2.** Large-scale providers of oyster reef data in the state of Florida

| Program                                     | Affiliation   | Region of map extent                 | Data origin, most recent data   | Classification scheme                         | Reference  |
|---|---|--------------------------------------|---|---|--|
| National Wetlands Inventory (NWI)           | U.S. Fish and Wildlife Service                          | National                             | Composite of multiple data and aerial image sources, image years vary from 1970s to 2010s | Cowardin et al. 1979                          | <a href="http://www.fws.gov/wetlands">www.fws.gov/wetlands</a>   |
| Florida Water Management Districts (WMD)    | NFWFMD  | NFWFMD                               | Color infrared or true color aerial photography, 2009-2010                                | FDOT 1999                                     | <a href="http://www.fgdl.org/metadateexplorer/explorer.jsp">www.fgdl.org/metadateexplorer/explorer.jsp</a>   |
| Land Use Land Cover (LULC) maps             | SRWMD   | SRWMD                                | Color infrared or true color aerial photography, 2010-2011                                | FDOT 1999                                     | <a href="http://www.srwmd.state.fl.us/index.aspx?NID=319">www.srwmd.state.fl.us/index.aspx?NID=319</a>   |
| SRWMD oyster mapping                        | SRWMD   | SRWMD                                | Composite of multiple data and aerial image sources, 2001                                 | Customized FDOT 1999                          | <a href="http://www.srwmd.state.fl.us/index.aspx?NID=319">www.srwmd.state.fl.us/index.aspx?NID=319</a>   |
| SWFWMD seagrass mapping                     | SWFWMD  | SWFWMD                               | Color aerial photography, oysters included in seagrass mapping efforts, 2016              | FDOT 1999                                     | <a href="http://data-sfwfwm.opendata.arcgis.com/">data-sfwfwm.opendata.arcgis.com/</a>   |
| Northern Coastal Basin Intercoastal Oysters | SJRWMD, UCF   | NE FL                                | Color aerial photography, 2009-2016   | Custom classification                         | <a href="http://www.arcgis.com/home/item.html?id=ac2979f9260e404f874a5f765daeaaa3">www.arcgis.com/home/item.html?id=ac2979f9260e404f874a5f765daeaaa3</a>                                     |
| Oyster Beds in Florida                      | Florida Fish and Wildlife Conservation Commission (FWC) | Florida                              | Compilation of many sources, see metadata. Source years vary, published in 2011           | FDOT 1999 and others                          | <a href="http://geodata.myfwc.com/datasets/a78160f5acaf4439b49f9fbef4c100ac_5">geodata.myfwc.com/datasets/a78160f5acaf4439b49f9fbef4c100ac_5</a>   |
| Cooperative Land Cover (CLC) map            | Florida Natural Areas Inventory, FWC                    | Florida                              | Compilation of many sources, see metadata. Version 3.2 published 2016                     | FNAI 1990, FDOT 1999, Kawula 2014, and others | <a href="http://FNAIandFWC2010myfwc.com/research/gis/applications/articles/Cooperative-Land-Cover">FNAI and FWC 2010 myfwc.com/research/gis/applications/articles/Cooperative-Land-Cover</a> |
| Gulf of Mexico Data Atlas                   | NOAA, Gulf of Mexico coast                              | Gulf of Mexico coast, all of Florida | Compilation of many sources, see metadata. Source years vary, published in 2011.          | FNAI 1990, FDOT 1999, and others              | <a href="http://gulfatlas.noaa.gov/catalog/living-marine/">gulfatlas.noaa.gov/catalog/living-marine/</a>   |

**Table 3.** Shellfish monitoring protocols.

| <b>Name</b>   | <b>Association</b>  | <b>Focus</b>   | <b>Reference</b>                       |
|---|---|--|--|
| Design and monitoring of shellfish restoration projects   | The Nature Conservancy  | Instructional guide for bivalve restoration projects and monitoring  | Brumbaugh et al. 2006                  |
| Oyster habitat restoration monitoring and assessment handbook   | NOAA, TNC, University of South Alabama, Florida Atlantic University | Instructional guide for monitoring and characterization of oyster restoration sites  | Baggett et al. 2014                    |
| Science-based restoration monitoring of coastal habitats  | NOAA  | Volume 1: A framework for monitoring plans under the estuaries and clean waters act of 2000; Volume 2: Tools for monitoring coastal habitats | Thayer et al. 2003, Thayer et al. 2005 |
| Best management practices for shellfish restoration   | Interstate Shellfish Sanitation Conference, TNC, NOAA               | Methods for shellfish restoration including community outreach and harvesting concerns   | Leonard and Macfarlane 2011            |
| Restoration goals, quantitative metrics and assessment protocols for evaluating success on restored oyster reef sanctuaries | Chesapeake Bay Program  | Monitoring protocols and success metrics for restored oyster reefs   | Oyster Metrics Workgroup 2011          |
| Effective monitoring to evaluate ecological restoration in the Gulf of Mexico   | National Research Council   | General and specific guidelines for monitoring numerous restored habitats, including oyster reefs  | NRC 2017                               |
| Oyster-generated marine habitats: their services, enhancement, restoration, and monitoring.                                 | Florida Atlantic University, University of Rhode Island             | TBD, in press  | Coen and Humphries, in press           |
| Oyster Condition Assessment Protocol  | UCF, SJRWMD, GTMNERR, NE Florida Aquatic Preserves                  | Instructional guide for standardized oyster reef monitoring  | Walters et al. in prep                 |

**Works Cited**

- Baggett, L. P., S. P. Powers, R. Brumbaugh, L. D. Coen, B. Deangelis, J. Greene, b. Hancock, and S. Morlock. 2014. Oyster habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA, 96 pp.
- Brumbaugh, R. D., M. W. Beck, L. D. Coen, L. Craig and P. Hicks. 2006. A Practitioners' Guide to the Design and Monitoring of Shellfish Restoration Projects: An Ecosystem Services Approach. The Nature Conservancy, Arlington, VA. 32 p.
- Coen, L.D. and A. Humphries. in press. Oyster-generated marine habitats: their services, enhancement, restoration, and monitoring. In: S. Murphy, and S. Allison, Eds., Routledge Handbook of Ecological and Environmental Restoration. Taylor & Francis Group, Routledge, Cambridge, U.K.
- Cowardin, L. M., V. Carter, F. C. Golet, and E. T. Laroe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31. 142 p.

- Dobson, J. E., E. A. Bright, R. L. Ferguson, D. W. Field, L. L. Wood, K. D. Haddad, H. Iredale III, J. R. Jensen, V. V. Klemas, R. J. Orth, and J. P. Thomas. 1995. NOAA Coastal Change Analysis Program (C-CAP): Guidance for Regional Implementation. 104 p.
- Florida Department of Transportation. 1999. Florida Land Use, Cover and Forms Classification System, 3rd edition. State Topographic Bureau, Thematic Mapping Section. 95 p.
- Federal Geographic Data Committee. 2012. Coastal and marine ecological classification standard. Marine and Coastal Spatial Data Subcommittee and Federal Geographic Data Committee. 353 p.
- Federal Geographic Data Committee. 2013. Classification of Wetlands and Deepwater Habitats of the United States. Adapted from Cowardin, Carter, Golet and LaRoe (1979). 90 p.
- Florida Natural Areas Inventory. 1990. Guide to the Natural Communities of Florida. Florida Natural Areas Inventory, Tallahassee. 120 p.
- Florida Natural Areas Inventory. 2010. Guide to the Natural Communities of Florida. Florida Natural Areas Inventory, Tallahassee, Florida. 8 p.
- Florida Natural Areas Inventory and Florida Fish and Wildlife Conservation Commission. 2010. Development of a Cooperative Land Cover Map: Final Report 15 July 2010. Florida's Wildlife Legacy Initiative Project 08009. 108 p.
- Kawula, R. 2009. Florida Land Cover Classification System, Final Report. Florida Fish and Wildlife Conservation Commission, Tallahassee. 71 p.
- Kawula, R. 2014. Florida Land Cover Classification System, Final Report, Revised. Florida Fish and Wildlife Conservation Commission, Tallahassee. 72 p.
- Klemas, V. V., J. E. Dobson, R. L. Ferguson, and K. D. Haddad. 1993. A coastal land-cover classification system to the NOAA Coastwatch Change Analysis Project. *Journal of Coastal Research* 9: 862–872.
- Leonard, D. and S. Macfarlane. 2011. Best Management Practices for Shellfish Restoration. Prepared for the ISSC Shellfish Restoration Committee. 91 p.
- Madley, K. A., B. Sargent, and F. J. Sargent. 2002. Development of a System for Classification of Habitats in Estuarine and Marine Environments (SCHEME) for Florida. Unpublished report to the U.S. Environmental Protection Agency, Gulf of Mexico Program (Grant Assistance Agreement MX-97408100). Florida Marine Research Institute, Florida Fish and Wildlife Conservation Commission, St. Petersburg. 43 pp.
- Meaux, K. L. 2011. Sarasota County water quality planning methods manual for field mapping of oysters. 34 p.
- National Research Council. 2017. Effective monitoring to evaluate ecological restoration in the Gulf of Mexico. Committee on Effective Approaches for Monitoring and Assessing Gulf of Mexico Restoration Activities, National Academies Press, Washington, D.C., 219 p.
- Oyster Metrics Workgroup. 2011. Restoration goals, quantitative metrics and assessment protocols for evaluating success on restored oyster reef sanctuaries. 32 p.
- Thayer, G. W., T. A. McTigue, R. J. Bellmer, F. M. Burrows, D. H. Merkey, A. D. Nickens, S. J. Lozano, P. F. Gayaldo, P. J. Polmateer, and P. T. Pinit. 2003. Science-Based Restoration Monitoring of Coastal Habitats, Volume One: A Framework for Monitoring Plans Under the Estuaries and Clean Waters Act of 2000 (Public Law 160-457). NOAA Coastal Ocean Program Decision Analysis Series No. 23, Volume 1. NOAA National Centers for Coastal Ocean Science, Silver Spring, MD. 35 pp. plus appendices.
- Thayer, G. W., T. A. McTigue, R. J. Salz, D. H. Merkey, F. M. Burrows, and P. F. Gayaldo (eds). 2005. Science-Based Restoration Monitoring of Coastal Habitats, Volume Two: Tools for Monitoring Coastal Habitats. NOAA Coastal Ocean Program Decision Analysis Series No. 23. NOAA National Centers for Coastal Ocean Science, Silver Spring MD. 628 pp. Plus appendices.
- Walters, L., R. Brockmeyer, E. Hernandez, N. Dix, A. S. Noel. in prep. Oyster Condition Assessment Protocol. 34 p.