

National Coastal Assessment 2010 Survey Design

Description of Sample Design

Target population: All coastal waters of the United States from the head-of-salt to confluence with ocean including inland waterways and major embayments such as Florida Bay and Cape Cod Bay.

Sample Frame: The sample frame was derived from prior National Coastal Assessment sample frame developed by ORD Gulf Breeze Ecology Division. The prior GED sample frame was enhanced as part of the National Coastal Monitoring Network design by including information from NOAA’s Coastal Assessment Framework, boundaries of National Estuary Programs and identification of major coastal systems. For NCA 2010 information on salinity zones was obtained from NOAA. For Delaware Bay, Chesapeake Bay, Puget Sound and state of South Carolina, the prior NCA sample frames were replaced by GIS layers provided by those organizations, ensuring that no prior areas in NCA were excluded and any differences clearly identified in the new NCA 2010 sample frame. For the Californian Province excluding San Francisco Bay, the GED sample frame was changed to match 2004 sample frame used for NCA 2004 study.

Survey Design: A Generalized Random Tessellation Stratified (GRTS) survey design for an area resource is used. The survey design is a stratified design with unequal probability of selection based on area within each stratum. The details are given below.

Stratification: Stratification is based on major estuaries based on NOAA Coastal Assessment framework and NEP estuaries. The table below identifies the major estuaries by combination of biogeographic province and estuary name. Those estuaries that were not identified as a major estuary within a biogeographical province are “Other”. The category “Exclude” includes portions of the sample frame that were excluded in NCA_2010 design. Of the 5107 km² that were excluded, 2875 km² were also excluded in NCA I to IV (mainly Canadian portion of Puget Sound). The remaining 2232 km² excluded includes 1401 km² in Strait of Juan de Fuca (Puget Sound) that has been demonstrated to be unsampleable, approximately 400 km² in tidal river portion of Columbia River and the remainder in tidal river portion of other rivers.

Major Estuary Group	NCA 2010	Included 2010 & Included NCAI-IV	Included 2010 but Excluded NCAI-IV	Excluded 2010 but Included NCAI-IV	# Sites NCA 2010	Area per Site
AP_Buzzards_Bay	577.7	577.7			11	52.5
AP_Casco_Bay	566.1	566.1			11	51.5
AP_Massachusetts_Bay	1,552.6	1,552.6		9.7	13	119.4
AP_New_Hampshire_Estuaries	56.5	56.5			12	4.7
AP_Penobscot_Bay	1,084.2	1,084.2		32.6	31	35.0

AP_Other	4,073.2	4,073.2		4.8	10	407.3
CalP_San_Francisco_Bay	1,146.0	1,146.0		2.7	26	44.1
CalP_Other	161.5	161.5		90.5	18	9.0
CarP_Albemarle_Pamlico_Sounds	8,518.7	8,518.7		13.4	34	250.6
CarP_Indian_River	894.9	894.9			9	99.4
CarP_St_Helena_Sound	197.7	189.2	8.5		27	7.3
CarP_Other	1,995.1	1,979.5	15.6	23.1	11	181.4
ColP_Lower_Columbia_River	179.5	179.5		412.3	10	18.0
ColP_Puget_Sound	5,859.0	5,859.0		1,418.0	44	133.2
ColP_Other	917.8	917.8		15.2	26	35.3
LP_Barataria_Terrabonne	2,458.4	2,458.4			6	409.7
LP_Coastal_Bend_Bays	3,240.2	3,240.2			7	462.9
LP_Galveston_Bay	1,477.5	1,477.5		5.3	14	105.5
LP_Mobile_Bay	1,084.3	1,084.3		36.6	16	67.8
LP_Apalachee_Bay	911.5	911.5			25	36.5
LP_Apalachicola_Bay	601.7	601.7		6.5	20	30.1
LP_Atchafalaya_Vermilion_Bay	1,939.3	1,939.3			10	193.9
LP_Breton_Chandeleur_Sound	4,388.0	4,388.0			11	398.9
LP_Matagorda_Bay	1,138.3	1,138.3		4.0	9	126.5
LP_Mississippi_River	476.4	476.4			15	31.8
LP_Pensacola_Bay	494.4	494.4			19	26.0
LP_San_Antonio_Bay	562.8	562.8			8	70.4
LP_West_Mississippi_Sound	4,530.3	4,530.3			11	411.8
LP_Other	2,942.7	2,942.7		35.0	26	113.2
VP_Chesapeake_Bay	11,664.5	11,660.4	4.1		46	253.6
VP_Delaware_Bay	2,002.6	1,971.8	30.8	86.9	20	100.1
VP_Long_Island_Sound	3,324.8	3,324.8		21.3	22	151.1
VP_Narragansett_Bay	368.8	368.8		1.2	11	33.5
VP_NY_NJ_Harbor	681.1	681.1		100.8	12	56.8
VP_Peconic_Bay	522.6	522.6			13	40.2
VP_NJ_Barnegat_Inland_Bays	553.8	553.8			12	46.2
VP_Other	2,093.6	2,093.6			11	190.3
WIP_Charlotte_Harbor	848.7	848.7		2.6	10	84.9
WIP_Tampa_Bay	952.7	952.7			8	119.1
WIP_Biscayne_Bay	714.2	714.2			11	64.9
WIP_Florida_Bay	3,246.0	3,246.0			8	405.8
WIP_Other	1,288.7	1,288.7			8	161.1
Total Area	82,689.9	82,630.9	59.0	2,322.4	682	121.2
HP_All	225.1	225.1			45	5.0
Puerto_Rico	176.3	176.3			45	3.9

Multi-density categories: Unequal probability categories were created based on area of polygons within each major estuary. The number of categories ranged from 3 to 7. The categories were used to ensure that sites were selected in the smaller polygons.

Panels: Design includes three panels. Revisit: identifies sites that are to be visited twice. Base: identifies remaining sites to be visited. Over: identifies sites available to be

used as replacement sites. Over sample sites were selected independent of the other two panels.

Expected sample size: Expected sample size 682 sites for conterminous coastal states and 45 sites for Hawaii and Puerto Rico. See table above. The maximum number of sites for a major estuary was 46 (Chesapeake Bay). Total number of site visits is 750 allocated to 682 unique sites and 68 sites to be revisited.

Over sample: Over sample size was selected to not only provide replacement sites that either are not part of the target population or could not be sampled but also to accommodate those states on National Estuary Programs who may want to increase the number of sites sampled within their state for a state-level design or NEP design.

Site Use: Sites should be used in SiteID order within each major estuary group or if enhancing for state or NEP design by SiteID order within state or NEP. If a revisit site can not be sampled the next site in the Base panel within the major estuary group should be used as revisit site.

Sample Frame Summary

See accompanying excel worksheet.

Site Selection Summary

See accompanying excel worksheet

Description of Sample Design Output:

See accompanying excel worksheet

Projection Information

```
ROJCS["NAD_1983_Albers",  
GEOGCS["GCS_North_American_1983",  
DATUM["D_North_American_1983",  
SPHEROID["GRS_1980",6378137.0,298.257222101]],  
PRIMEM["Greenwich",0.0],  
UNIT["Degree",0.0174532925199433]],  
PROJECTION["Albers"],  
PARAMETER["False_Easting",0.0],  
PARAMETER["False_Northing",0.0],  
PARAMETER["Central_Meridian",-96.0],  
PARAMETER["Standard_Parallel_1",29.5],  
PARAMETER["Standard_Parallel_2",45.5],  
PARAMETER["Latitude_Of_Origin",23.0],  
UNIT["Meter",1.0]]
```

Evaluation Process

The survey design weights that are given in the design file assume that the survey design is implemented as designed. Typically, users prefer to replace sites that can not be sampled with other sites to achieve the sample size planned. The site replacement process is described above. When sites are replaced, the survey design weights are no longer correct and must be adjusted. The weight adjustment requires knowing what happened to each site in the base design and the over sample sites. EvalStatus is initially set to "NotEval" to indicate that the site has yet to be evaluated for sampling. When a site is evaluated for sampling, then the EvalStatus for the site must be changed.

Recommended codes are:

EvalStatus Code	Name	Meaning
TS	Target Sampled	site is a member of the target population and was sampled
LD	Landowner Denial	landowner denied access to the site
PB	Physical Barrier	physical barrier prevented access to the site
NT	Non-Target	site is not a member of the target population
NN	Not Needed	site is a member of the over sample and was not evaluated for sampling
Other codes		Many times useful to have other codes. For example, rather than use NT, may use specific codes indicating why the site was non-target.

Statistical Analysis

Any statistical analysis of data must incorporate information about the monitoring survey design. In particular, when estimates of characteristics for the entire target population are computed, the statistical analysis must account for any stratification or unequal probability selection in the design. Procedures for doing this are available from the Aquatic Resource Monitoring web page given in the bibliography. A statistical analysis library of functions is available from the web page to do common population estimates in the statistical software environment R.

For further information, contact

Anthony (Tony) R. Olsen
USEPA NHEERL
Western Ecology Division
200 S.W. 35th Street
Corvallis, OR 97333
Voice: (541) 754-4790
Fax: (541) 754-4716
email: Olsen.Tony@epa.gov

Bibliography:

Diaz-Ramos, S., D. L. Stevens, Jr, and A. R. Olsen. 1996. EMAP Statistical Methods Manual. EPA/620/R-96/002, U.S. Environmental Protection Agency, Office of Research and Development, NHEERL-Western Ecology Division, Corvallis, Oregon.

Stevens, D.L., Jr. 1997. Variable density grid-based sampling designs for continuous spatial populations. *Environmetrics*, 8:167-95.

Stevens, D.L., Jr. and Olsen, A.R. 1999. Spatially restricted surveys over time for aquatic resources. *Journal of Agricultural, Biological, and Environmental Statistics*, 4:415-428

Stevens, D. L., Jr., and A. R. Olsen. 2003. Variance estimation for spatially balanced samples of environmental resources. *Environmetrics* **14**:593-610.

Stevens, D. L., Jr., and A. R. Olsen. 2004. Spatially-balanced sampling of natural resources in the presence of frame imperfections. *Journal of American Statistical Association*:99:262-278.

Horn, C.R. and Grayman, W.M. (1993) Water-quality modeling with EPA reach file system. *Journal of Water Resources Planning and Management*, 119, 262-74.

Strahler, A.N. 1957. Quantitative Analysis of Watershed Geomorphology. *Trans. Am. Geophys. Un.* 38,913-920.

Web Page: <http://www.epa.gov/nheerl/arm>