

A Comparison of C-CAP Land Cover Data from 1996 and 2006 within the Coastal Drainage Watershed of New Hampshire

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Introduction

As part of the Estuarine Habitat Program of NOAA'S Coastal Ocean Program a nationally standardized database on land cover of the coastal regions of the United States was created called the Coastal Change Analysis Program (C-CAP). Data were collected on a 1 to 5 year cycle of the coastal habitats and the adjacent uplands. These data include a combination of satellite imagery, aerial photography, and field data that are integrated into a GIS and are distributed in a digital form for anyone to use. In this project, C-CAP data were obtained for the Seacoast of New Hampshire for the years 1996 and 2006. The data were clipped to include only the Coastal Drainage Watershed.

Objective

The objective of this study was to compare the 1996 and 2006 C-CAP datasets to determine the layer usability for land cover change analyses in the Coastal Drainage Watershed in New Hampshire.

C-CAP Land Cover Classification Scheme

The following is a table of the C-CAP classification scheme used and a short explanation of the land cover classes.

Table 1. C-CAP Land Cover Classification Scheme

Value	Classification	Description:
0	Background	area within the image file the limits but containing no data
1	Unclassified	areas in which land cover cannot be determined, these include clouds and deep shadow
2	Developed High Intensity Land (DHI)	contains significant land area is covered by concrete, asphalt and other construction materials. Vegetation occupies <20 % of the landscape.
3	Developed Medium Intensity Land (DMI)	contains areas with a mixture of constructed materials and vegetation. Constructed materials account for 50 - 79 % of total area
4	Developed Low Intensity (DLI)	contains areas with a mixture of constructed materials and substantial vegetation. Constructed materials account for 21-49% of total area.
5	Developed Open Space (DOS)	contains areas with a mixture of some constructed materials, but mostly managed grasses or low lying vegetation planted for recreation, erosion control or aesthetics.
6	Cultivated Crops (CC)	contains areas intensely managed for the production of annual crops
7	Pasture/Hay (PH)	contains areas of grasses, legumes or grass-legume mixtures planted for livestock grazing of the production of seed or hay crops
8	Grassland/Herbaceous (GH)	contains areas dominated by grammanoid or herbaceous vegetation generally 80% of total vegetation
9	Deciduous Forest (DF)	contains areas dominated by trees generally greater than 5 meters tall and greater than 20 % of total vegetation cover. More than 75% of trees shed foliage.
10	Evergreen Forest (EF)	contains areas dominated by trees generally greater than 5 meters tall and greater than 20 % of total vegetation cover. More than 75% of trees maintain their leaves all year
11	Mixed Forest (MF)	contains areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous or evergreen species are greater than 75% of total tree cover.
12	Scrub/Shrub (SS)	contains areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation
13	Palustrine Forested Wetland (PFW)	includes tidal and non-tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height. Salinity is below 0.5%. Total vegetation coverage is greater than 20%
14	Palustrine Scrub/Shrub Wetland (PSSW)	includes tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height. Salinity is below 0.5%. Total vegetation coverage is greater than 20%
15	Palustrine Emergent Wetland (PEW)	includes tidal and non-tidal wetlands dominated by persistent emergent vascular plants, mosses and lichens. Salinity less than 0.5%. Total vegetation greater than 80%
16	Estuarine Forested Wetland (EFW)	includes tidal and non-tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height. Salinity greater than or equal to 0.5%. Total vegetation cover >20%.
17	Estuarine Scrub/Shrub Wetland (ESSW)	includes tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height. Salinity is below 0.5%. Total vegetation coverage is greater than 20%
18	Estuarine Emergent Wetland (EEW)	includes all tidal wetlands dominated by erect, rooted, herbaceous hydrophytes (excluding mosses and lichens). Salinity >20%. Total vegetation cover >80%.
19	Unconsolidated Shore (US)	includes material such as silt sand or gravel that is subject to inundation and redistribution due to the action of water.
20	Barren Land (BL)	contains areas of bedrock, desert pavement, scarp, talus, slides etc. Vegetation accounts for less than 10% of total cover.
21	Open Water (OW)	include areas of open water, generally with less than 25 % cover of vegetation or soil
22	Palustrine Aquatic Bed (PAB)	includes tidal and non-tidal wetlands and deep water habitats. Salinity is below 0.5%. Total vegetation cover is greater than 80%.
23	Estuarine Aquatic Bed (EAB)	includes tidal wetlands and deep water habitats. Salinity is greater than or equal to 0.5%. Total vegetation cover is greater than 80%.
24	Tundra	a treeless region beyond the latitudinal limit of the boreal forest in pole-ward regions
25	Perennial Ice/Snow	includes areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.

C-CAP Land Cover Data

Figure 1 and Figure 2 show the resulting Land Cover data for the Coastal Drainage Watershed for the years 1996 and 2006 respectively.

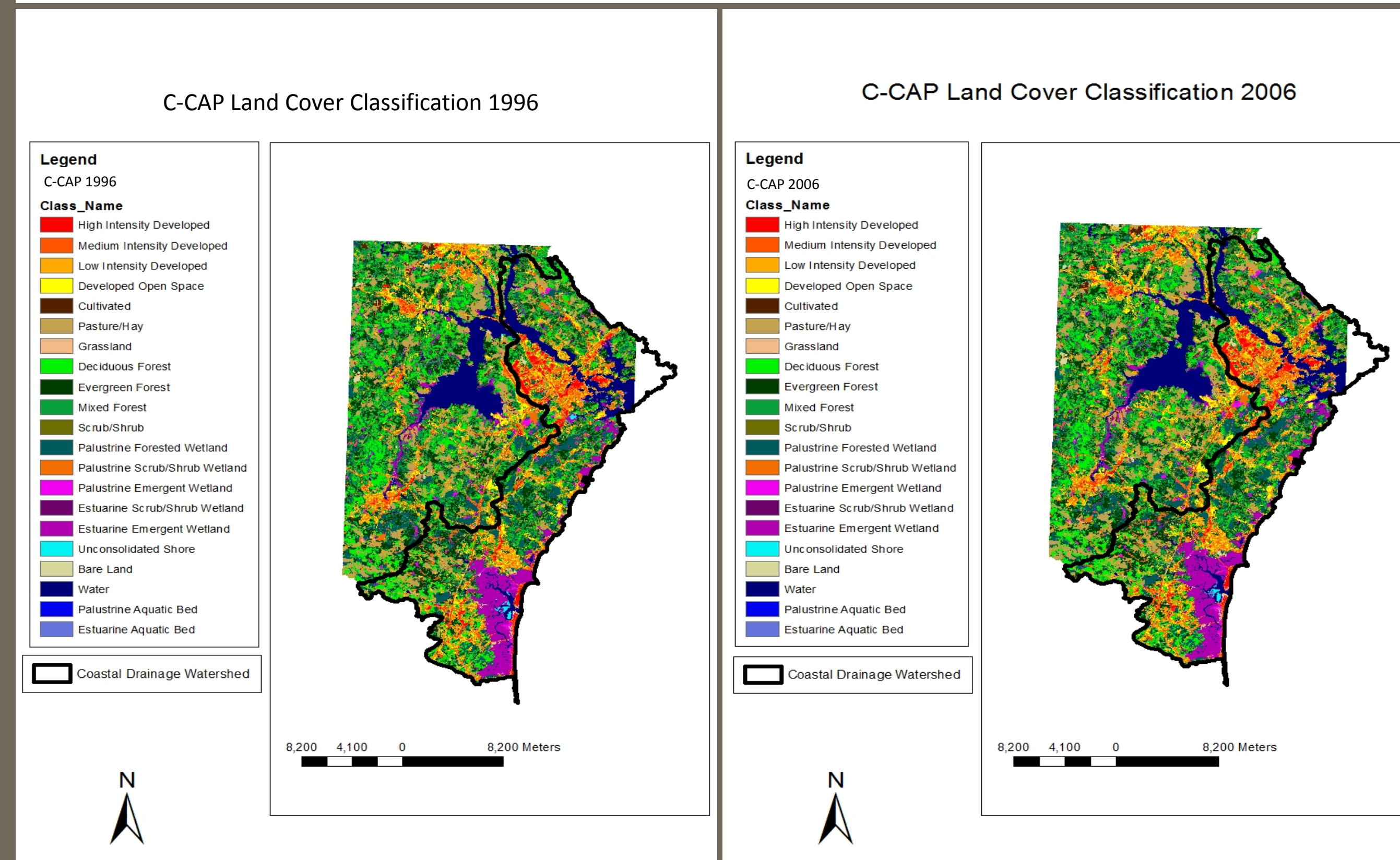


Figure 1. Areas of development are shown in red, orange, and yellow.

Figure 2. Areas of development are also shown in red, orange and yellow.

Comparing Data Layers

1996 C-CAP Land Cover Layer:

- Created by: Sanborn Mapping Company
- Change Detection Method: Change mask based on 2001 data
- Classification Method: CART Analysis

2006 C-CAP Land Cover Layer:

- Created by: MDA Federal
- Change Detection Method: Cross Correlation Analysis based on 2001 data
- Classification Method: CART Analysis

2001 C-CAP Land Cover Layer:

- Created by: Sanborn Mapping Company
- Pre-processing: a combination of Landsat TM data and field data
- Classification Method: CART Analysis

Based on the data above, we can see that the 1996 and 2006 datasets were based on the 2001 land cover layer.

An accuracy assessment was performed on the 2001 layer by Sanborn, and was found to have an overall accuracy of 85.1% and a Kappa value of 0.848. As a result of the 1996 and 2006 layers being derived from the 2001 dataset, they should have comparable accuracy values.

Table 2. A change matrix comparing the 1996 and 2006 land cover data layers. Values highlighted in blue represent amounts of unchanged land from 1996 to 2006.

		2006 C-CAP Coverage (ha) (Coastal Drainage Watershed)																Totals							
		DHI	DMI	DLI	DOS	CC	PH	GH	DF	EF	MF	SS	PFW	PSSW	PEW	EFW	ESSW	EEW	US	BL	OW	PAB	EAB		
1996 C-CAP Coverage (ha) (Coastal Drainage Watershed)	DHI	1036	196	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1250	
	DMI	72	2310	127	23	3	0	0	2	2	0	5	1	0	0	0	0	0	0	0	7	0	0	2553	
	DLI	2	1636	3076	1752	0	1	1	53	11	58	2	2	5	0	0	0	2	0	4	0	0	0	6605	
	DOS	0	7	239	1091	0	3	0	17	1	6	2	0	0	0	0	0	0	0	0	0	0	0	0	1366
	CC	0	0	0	0	121	15	0	4	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	150
	PH	0	0	1	4	111	2246	124	129	44	92	492	0	14	0	0	0	0	0	0	0	7	0	0	3266
	GH	0	0	0	0	0	4	203	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	214
	DF	0	50	306	15	10	642	0	3255	360	556	1685	183	2	42	0	0	27	0	135	0	0	0	0	7268
	EF	0	7	162	25	57	27	0	251	4135	1818	2451	390	28	150	0	0	141	0	323	5	0	0	0	9969
	MF	0	2	29	9	0	1	2	152	106	3191	427	41	32	40	0	0	60	0	240	2	0	0	0	4335
	SS	0	2	9	1	1	28	13	135	84	128	928	1	1	1	0	0	0	0	3	1	0	0	0	1337
	PFW	0	18	122	0	0	2	0	469	191	419	29	2851	28	190	0	0	19	0	7	0	0	0	0	4346
	PSSW	0	0	0	0	0	1	0	6	0	8	2	0	497	1	0	0	0	0	0	0	0	0	0	516
	PEW	0	0	0	0	0	0	0	2	8	10	11	3	1	444	0	0	0	0	5	0	0	0	0	484
	EFW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ESSW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	EEW	0	0	0	0	0	0	0	959	2	115	0	485	0	0	0	0	0	2645	4067	99	15299	0	0	23672
	US	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	129	1	65	0	0	262
	BL	1	68	33	1	3	10	1	52	21	34	5	2	0	8	0	0	2	31	251	18	0	0	0	540
	OW	0	0	0	0	0	0	0	0	850	3	2	0	0	0	0	0	1381	2938	903	2354	0	182	0	8614
	PAB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	12	0	68	123
	Totals:	1111	4296	4120	2922	307	2979	346	5485	5821	6439	6047	3961	608	876	0	1	4300	7208	1990	17756	0	294	76867	

The change matrix shows the changes (in ha.) in land cover classes from 1996 to 2006. The row and column totals show the total area represented by each land cover class for that year. The values represent realistic amounts of land cover and therefore give more evidence to the fact that the 1996 and 2006 layers are enough alike to be used in such analyses.

	1996 (ha)	2006 (ha)	Change (ha)	% Change
DHI	1249.75	1110.94	138.81	11.10702
DMI	2552.69	4295.77	-1743.08	-68.284
DLI	6605.17	4119.95	2485.22	37.62538
DF	7267.92	5484.91	1783.01	24.5326
EF	9968.88	5820.83	4148.05	41.60999
MF	4334.76	6439.49	-2104.73	-48.5547

Table 3. Examples of land change percentages resulting from the above change matrix.

- As expected, Developed land cover types increased.
- Also, as expected, the area covered by forests decreased (Mixed forest increased but overall forest decreased).

Conclusions

- The land cover maps derived from the C-CAP imagery follow similar protocols and the same classification scheme and are therefore appropriate to use in land cover change analysis.
 - Although the 1996 and 2006 layers were produced by two different companies using different change detection methods, the results of these maps are directly comparable.
 - The two datasets were derivatives of the same 2001 land cover map.
 - The 2001 layer was created using field data and high resolution imagery.

Future Use

The land cover maps have proven to be appropriate for use in a land cover change analysis. Therefore, the results derived from the comparison of these two layers can be accepted as accurate and can be used for analysis of the Coastal Drainage Watershed of New Hampshire.

Acknowledgements

This work was part of an New Hampshire View Undergraduate Internship. The author would like to thank New Hampshire View, Ms. Meghan Maclean, and Dr. Russ Congalton for their support.

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For more information please see: www.nhview.unh.edu



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