Complexities of Resilience: Adaptation and Change within Human Communities of Coastal Louisiana

Conner Bailey, Robert Gramling and Shirley B. Laska

Abstract

Coastal ecosystems and particularly deltaic coastal ecosystems are among the most productive in the world, and this certainly is true of coastal Louisiana. Residents have a long history of fishing, hunting, cattle raising, and farming, which means that they have drawn on a diversity of natural resources and engaged in a seasonal round of activities that has limited their vulnerability to loss associated with any one activity. Such resilience among residents of coastal Louisiana increasingly is challenged by a number of factors outside their control such as sea-level rise, increased strength of tropical storms, subsidence, and loss of wetlands due to these and other factors. Local residents have a storehouse of ecological knowledge based on generations of living with storms but are increasingly facing the need to make decisions about strategic retreat from the coast. Strong emotional ties link people to the land and water of coastal Louisiana as well as to their cultural communities. We document how residents of coastal Louisiana are in the process of adapting to changing conditions and identify four different approaches that might be taken by coastal residents in the future.

Keywords

Resilience · Coastal communities · Adaptation culture · Population change · Relocation

Introduction

Coastal ecosystems and particularly deltaic coastal ecosystems are among the most productive in the world, and this certainly is true of coastal Louisiana. The high natural productivity and diversity of ecological niches support a wide range of human activities. In coastal Louisiana, residents have a long history of fishing, hunting, cattle raising, and farming in a seasonal round of activities that limits their vulnerability to loss associated with any one activity. In more recent years, the oil industry added to the diversification with important employment and income opportunities for coastal residents. During boom times in the oil patch, farming and fishing declined in relative importance, but these activities continued

The authors, listed in alphabetical order, made equal contributions to this paper.

C. Bailey (✉)
College of Agriculture, Auburn University, Auburn, AL, USA
e-mail: cbailey@acesag.auburn.edu

R. Gramling
Department of Sociology, Anthropology and Child and Family Studies, University of Louisiana-Lafayette, Lafayette, LA, USA
e-mail: gramling@louisiana.edu

S. B. Laska
Department of Sociology, University of New Orleans, New Orleans, LA, USA
e-mail: slaska@uno.edu

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to be practiced and remained as effective safety nets when the oil industry went into periodic decline.

Such resilience among residents of coastal Louisiana is increasingly challenged by a number of factors outside their control. These include eustatic sea level rise and increased strength of tropical storms associated with global climate change, land subsidence caused locally by consolidation of sediments, and loss of wetlands due to these and other factors. The geologic history of delta formation and erosion due to shifts in river course and sediment deposition resulted in a dynamic system. More recently, human efforts to control this system have led to its serious degradation through the loss of sediment with the channelization and containment of the Mississippi River. This process has been exacerbated by the cutting of channels through coastal wetlands for oil and gas exploration and transportation, leading to saline intrusion into freshwater ecosystems. Loss of coastal wetlands has threatened human settlements throughout coastal Louisiana and amplified their vulnerability to damage from tropical storm events. Local residents have a storehouse of knowledge based on generations of living with coastal land loss and the effect the loss has on storm impact, but are increasingly facing the need to make more drastic decisions in response to them, namely strategic retreat from the coast.

Much has been written on the cultural history of coastal Louisiana, and much of this literature describes the intense personal attachment that residents have to this ecosystem as both home and source of sustenance. Strong emotional ties link people to the land and water of coastal Louisiana as well as to their cultural communities. As much as anywhere on earth, the place literally defines the person. Coastal parishes of Louisiana are home to a unique cultural landscape of cuisine, music, and language found nowhere else. People are understandably reluctant to turn their back on this heritage even in the face of impending ecological disaster. Their ancestors are buried there. They own land, homes, businesses and other fixed material assets that they are loath to abandon. More importantly the large extended families and tight social networks living and working supportively constitute a valuable resource. As one young Cajun woman from a large family remarked when leaving the area for a doctoral program in the West, "I don't know if I can function outside of the social network in which I was raised. It is like being one leg of a starfish."

In this chapter we document how residents of coastal Louisiana are in the process of adapting to changing conditions. We argue that humans are by nature a highly adaptive species and that humans living in dynamic ecosystems such as coastal Louisiana are culturally disposed to adaptive behaviors that create personal, community, and social resilience. The concept has particular use in this context because significant changes are underway in the biophysical environment, as documented elsewhere in this book, and these changes are forcing coastal residents of Louisiana to make difficult decisions that affect their lives and livelihoods. We document population mobility over the past 30 years to show that the people of coastal Louisiana already have been making difficult decisions to move, but have done so in a measured manner. We identify four different approaches that might be taken by coastal residents in the future, and argue that the role of science is to help people make the best decisions they can make.

Twenty Years of Population Change

Data on population change in ten coastal Louisiana parishes between 2000 and 2010 is presented in Table 1. Taken as a whole, these ten parishes have lost over 180,000 people during that time period. Most of that population loss occurred after Hurricanes Katrina and Rita in 2005, but evidence of a slow decline in population can be seen before that. A dramatic decline occurred between July 2005 and 2006, with a loss of 332,000 people over that 1 year and relative population stability between 2008 and 2010.

Looking more closely at the data in Table 1, we see variation among parishes with the largest losses in absolute terms occurring in Orleans parish but with proportionately higher losses occurring in St. Bernard Parish and Cameron Parish. Plaquemines Parish also suffered a significant loss of population during the period 2000–2010, with most of this loss occurring after 2005. Some coastal parishes increased in population size during both periods, though growth rates were modest. By way of comparison, the state of Louisiana grew by 1.4% between 2000 and 2010 (U.S. Census Bureau 2000, 2010).

The U.S. Census Bureau also provides population estimates for "Places," defined as either incorporated communities or census-designated places which, while not incorporated, represent densely settled concentrations of population that are locally identified by name. Table 2 presents data on population change of all census Places in coastal parishes of Louisiana except for the city of New Orleans, which dwarfs in size all other communities shown in Table 2. New Orleans lost more than a quarter of its population between 2000 and 2010, while the remaining Census Places in these ten parishes taken as a whole lost two percent.

Leaving New Orleans city and parish out of the equation, there are nearly 900,000 coastal residents, with roughly 150,000 in Census Places. This means that about 750,000 people living in coastal Louisiana live outside of Census Places as defined by the U.S. Census Bureau. In other words, the majority of the coastal population is very rural. Due to the unique topographical features of the Mississippi Delta, populations tend to follow linear patterns of settlement, with homes following the high ground associated with natural

Table 1 Population change in 10 coastal Louisiana Parishes, 2000–2010. (Sources: U.S. Census Bureau. n.d. American fact finder. Accessed on 18 Aug 2012)

	Cameron Parish, Louisiana	Iberia Parish, Louisiana	Jefferson Parish, Louisiana	Lafourche Parish, Louisiana	Orleans Parish, Louisiana	Plaquemines Parish, Louisiana	St. Bernard Parish, Louisiana	St. Mary Parish, Louisiana	Terrebonne Parish, Louisiana	Vermilion Parish, Louisiana	Totals
2010	6,839	73,240	432,552	96,318	343,829	23,042	35,897	54,650	111,860	57,999	1,236,226
2009	6,584	75,101	443,342	93,682	354,850	20,942	40,655	50,815	109,291	56,141	1,251,403
2008	7,100	75,020	444,655	93,556	336,644	21,138	37,669	51,005	109,161	56,068	1,232,016
2007	7,228	74,810	440,339	92,881	288,113	21,353	33,439	51,163	108,627	55,629	1,173,582
2006	7,457	74,481	420,683	92,780	208,548	21,293	14,493	51,569	108,115	55,313	1,054,732
2005	9,576	73,599	451,652	91,362	455,188	28,549	64,951	50,871	106,192	54,909	1,386,849
2004	9,636	73,399	452,678	91,624	461,915	28,602	65,427	51,541	105,453	54,368	1,394,643
2003	9,688	73,390	451,533	91,236	467,761	27,644	65,727	51,898	105,172	54,161	1,398,210
2002	9,736	73,345	451,453	90,666	472,744	27,119	66,286	52,189	104,923	54,223	1,402,684
2001	9,834	73,277	452,088	90,054	477,932	26,852	66,554	52,528	104,729	53,952	1,407,800
2000	9,949	73,234	454,738	89,974	483,663	26,737	66,988	53,256	104,461	53,966	1,416,966
2010 as % of 2000	0.662	1.025	0.975	1.041	0.734	0.783	0.607	1.026	1.046	1.040	0.872
2010 as % Of 2005	0.688	1.020	0.982	1.025	0.780	0.734	0.626	1.074	1.029	1.022	0.891

Table 2 Population change affecting census places in 10 coastal Parishes in Louisiana, 2000–2010. (Sources: U.S. Census Bureau. n.d. American Fact Finder. Accessed on 18 Aug 2012)

Place	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	% change
Kenner city, Jefferson Parish	66,702	67,842	68,220	67,774	64,933	69,716	70,105	70,067	70,294	69,902	70,375	0.948
Houma city, Terrebonne Parish	33,727	32,584	32,685	32,679	32,786	32,215	32,201	32,391	32,521	32,678	32,835	1.027
Gretna city, Jefferson Parish	17,736	16,783	16,861	16,751	16,040	17,275	17,306	17,311	17,282	17,399	17,545	1.011
Abbeville city, Vermilion Parish	12,257	12,229	12,088	11,646	11,691	11,606	11,611	11,666	11,791	11,823	11,910	1.029
Kaplan city, Vermilion Parish	4,600	4,997	5,049	5,093	5,141	5,103	5,104	5,130	5,172	5,180	5,215	0.882
Lockport town, Lafourche Parish	2,578	2,691	2,636	2,664	2,596	2,569	2,586	2,600	2,608	2,613	2,621	0.984
Jean Lafitte town, Jefferson Parish	1,903	2,308	2,309	2,284	2,140	2,297	2,281	2,263	2,226	2,180	2,146	0.887
Erath town, Vermilion Parish	2,114	2,156	2,174	2,180	2,181	2,166	2,161	2,171	2,185	2,191	2,192	0.964
Delcambre town Vermilion Parish (part)	1,866	1,522	1,533	1,541	1,551	1,539	1,537	1,547	1,561	1,558	1,566	1.192
Golden Meadow town, Lafourche Parish	2,101	2,096	2,121	2,134	2,149	2,130	2,147	2,158	2,165	2,168	2,188	0.960
Grand Isle town, Jefferson Parish	1,296	1,677	1,650	1,582	1,481	1,590	1,601	1,582	1,568	1,557	1,544	0.839
Gueydan town, Vermilion Parish	1,398	1,591	1,601	1,608	1,614	1,602	1,599	1,602	1,611	1,605	1,607	0.870
Totals	148,278	148,476	148,927	147,936	144,303	149,808	150,239	150,488	150,984	150,854	151,744	0.977

Table 3 Tenure and mobility, United States, Louisiana, and selected coastal Louisiana parishes, 1985–2010. (Sources: Data for 1990 and 2000 are from the US Census Bureau, Censuses of 1990 and 2000. 2010 data for percent of owner occupied homes was from the 2010 Census. Data for population living more than 5 years in the same house are from the American Community Survey 2006–2010 (Selected Housing Characteristics, 2006–2010 American Community Survey 5-year Estimates, Table DP04))

Year	Variable	U.S.	Louisiana	Jefferson	Lafourche	Plaquemines	St. Bernard	Terrebonne	Orleans
1990	Percent homes owner occupied	64.2	65.9	62.9	75.7	75.9	75.8	73.2	43.7
	Percent population more than 5 years in same house	53.3	59.3	59.4	66.3	64.5	65.3	62.7	54.7
2000	Percent homes owner occupied	66.2	67.9	63.9	77.9	78.9	74.7	75.5	46.5
	Percent population more than 5 years in same house	54.1	59.0	61.4	66.9	65.5	65.1	62.4	56.8
2010	Percent homes owner occupied	65.1	67.2	63.7	75.8	74.8	68.8	72.2	47.8
	Percent population more than 5 years in same house	59.2	58.1	64.2	72.7	48.6	38.0	68.1	49.5

Note: for 1990 and 2000, the Census wording was "percent population over 5 years of age living in the same house" in 1985 and 1990, respectively. For 2010 the wording was changed and this new wording is used in this and subsequent tables

levees, cheniers, barrier island beaches and roadways. This presents a number of difficulties in providing social services including water, fire, police, and schools, and also represents a significant challenge to protecting homes and other community structures against damage from storms. Moreover, most Census Places are themselves relatively small. The largest is Kenner, essentially a suburb of New Orleans. Next in size is Houma, with a population of roughly 34,000. There were only two other Census Place over 5,000 in 2009 and only four over 2,500 people, underscoring the essentially rural nature of the coastal population.

Data presented in Tables 1 and 2 indicate that over the past decade some residents of coastal Louisiana have moved away, quite possibly in reaction to perceived risk associated with storms hitting an eroding coastline. This retreat appears to be affecting both Census Places (places with relatively dense populations) and rural residents. The severe damage in Orleans Parish accounts for most of the population decline in terms of sheer numbers. Table 1 also shows that three parishes experienced even more dramatic declines in population as a percent of population. These include Cameron Parish, a largely rural parish in western Louisiana, and both Plaquemines and St. Bernard parishes in the east. All three parishes lost significant population between 2005 and 2010, with St. Bernard Parish experiencing the largest drop (well over one-third of its population). The six other coastal parishes (Vermillion, Iberia, St. Mary, Terrebonne, Lafourche and Jefferson), however, had slight changes, either increasing or decreasing.

In Table 3, parish-level data are presented on the percent of homes which are owner-occupied and the percentage of the population who lived in the same house 5 years prior to the two most recently published census results (i.e., 1985 for the 1990 Census, 1995 for the 2000 census, and 2005 for the 2010 Census). Two metropolitan parishes (Jefferson and Orleans) as well as four coastal parishes from eastern Louisiana (Lafourche, Plaquemines, St. Bernard and Terrebonne) are compared to U.S. and Louisiana figures. From these data, we see that the percent of owner-occupied homes in the U.S. and Louisiana are roughly comparable, but that the four rural coastal parishes have significantly higher percentages of owner-occupied homes. Home ownership is a primary mechanism for building personal and family wealth in the U.S. Home ownership also represents an investment in a specific place and community. Residents of rural coastal parishes in eastern Louisiana are more heavily invested in home ownership and all that entails than are most Americans.

Table 3 also contains data on residential mobility. Louisiana residents in general are somewhat less mobile than the average American, with a higher percentage living in the same house as 5 years previously. The 1990 and 2000 Census data show that residents of the four rural coastal parishes of eastern Louisiana (Lafourche, Plaquemines, St. Bernard and Terrebonne) have been even less mobile than others in the state (including the metro coastal parishes of Jefferson and Orleans) and quite a bit less mobile than the national average. Moreover, there is little variation between the two census periods. The attachment to place continued to that date. Results of the 2010 Census give us a different picture for Plaquemines and St. Bernard Parishes, the two parishes most hard hit by hurricane Katrina. From nearly two-thirds of the population in these two parishes living in the same house as 5 years ago, in St. Bernard Parish that figure dropped to 38 and 49% in Plaquemines Parish. In contrast, data for Terrebonne and Lafourche Parishes reflect continuity in the form of a relatively stable population of homeowners.

Parish level data are problematic as many parishes contain land that is not immediately subject to storm surge and flooding while other parts of the parishes are vulnerable. In Tables 4 and 5, we present data at the Census Tract level

Table 4 Population, tenure and mobility, Census Tracts of Plaquemines Parish, Louisiana, 1985–2000. (Sources: Data for 1990 and 2000 are from the US Census Bureau, Censuses of 1990 and 2000. 2010 data for population and percent of owner occupied homes was from the 2010 Census. Data for population living more than 5 years in the same house are from the American Community Survey 2006–2010 (Selected Housing Characteristics, 2006–2010 American Community Survey 5-year Estimates, Table DP04))

Year	Variable	Tract number							
		501	502	503	504	505	506	507	508
1990	Population	2,364	5,715	2,797	2,537	2,951	2,681	3,746	2,784
	Percent homes owner occupied	87.6	69.1	47.9	82.5	88.3	79.1	74.7	87.9
	Percent population over 5 years age living in same house as in 1985	74.7	42.9	62.2	22.8	18.6	28.4	45.7	24.7
2000	Population	3,025	5,970	2,878	3,428	2,745	2,075	3,418	2,218
	Percent homes owner occupied	87.3	74.9	49.4	90.2	87.2	82.6	79.2	88.8
	Percent population over 5 years age living in same house as in 1995	73.6	60.0	40.4	66.8	80.8	67.4	70.1	74.7
2010	Population	1,659	9,456	4,992	3,320	1,032	548	868	980
	Percent homes owner occupied	88.5	76.9	38.1	90.7	89.1	88.5	85.0	87.0
	Percent of population more than 5 years in same house	41.8	62.8	37.9	46.3	36.9	31.0	31.0	22.7

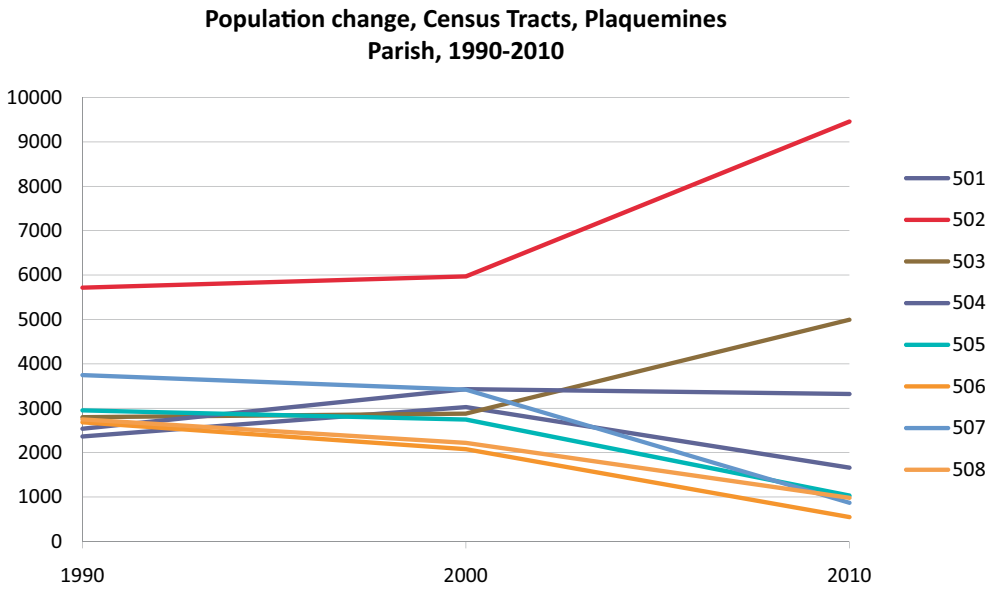

Fig. 1 Population change, census tracts, Plaquemines Parish, 1990–2010. For references, see Table 4.

for Plaquemines and St. Bernard Parishes. Census tracts are units of analysis used by the Census Bureau to cover populations of approximately 4,000 people and are designed to be stable between one decennial census period and another.

Population Change in Plaquemines Parish

In Plaquemines Parish, three census tracts (502, 503 and 504) gained population between 1990 and 2010 (Table 4; Figure 1). Most of this growth was in tracts 502 and 503 and was particularly dramatic between 2000 and 2010. Within Plaquemines Parish, these two tracts are the ones furthest from the Gulf of Mexico and population growth in these areas might reflect a gradual retreat of people from tracts closer to the Gulf (the Census data do not allow for direct measure of that question).

The population of Tract 501 grew from 1990 to 2000 but then was cut nearly in half in 2010, almost certainly as a result of hurricane Katrina. Tract 501 essentially covers the entire northeast side of the Mississippi River from the Southwest Pass to St. Bernard Parish. Virtually all of the population in this census tract is to be found in the census blocks in the far north, furthest away from the Gulf of Mexico nestled up next to Tracts 502 and 503. Tract 504 lies southwest along the Mississippi River and, like Tract 501, the population of Tract 504 is concentrated in the furthest reaches north and the furthest from the Gulf of Mexico. The remaining four census tracts lost 14% of their population between 1990 and 2000, a figure that balloons to over 70% by 2010. Declines were least in the census tracts of the towns of Port Sulfur and

Table 5 Population, Tenure and mobility, Census Tracts of St. Bernard Parish, Louisiana, 1990–2010. (Sources: Data for 1990 and 2000 are from the US Census Bureau, Censuses of 1990 and 2000. 2010 data for population and percent of owner occupied homes was from the 2010 Census. Data for population living more than 5 years in the same house are from the American Community Survey 2006–2010 (Selected Housing Characteristics, 2006–2010 American Community Survey 5-year Estimates, Table DP04). The symbol "X" indicates where old census tract numbers were discontinued or new census tracts were created)

Variable		Tract Number																			
		301.01	301.02	301.03	301.04	301.05	302.03	302.04	302.05	302.06	302.07	302.08	302.09	303	304	305	306.01	306.02	306.03	307	308
1990	Population	1,613	9,270	X	X	X	4,672	6,634	8,467	3,718	5,995	X	X	2,404	2,814	3,569	3,047	4,194	2,808	2,290	5,136
	Percent homes owner occupied	90.7	84.4	X	X	X	76.8	79.0	85.0	95.8	83.3	X	X	57.2	79.8	91.0	77.6	83.5	9.4	63.9	52.9
	Percent population over 5 years age living in same house as 1985	68.4	61.9	X	X	X	68.5	55.5	63.9	80.8	76.4	X	X	61.9	66.1	78.5	79.9	72.2	14.0	64.0	61.5
2000	Population	1,321	X	6,705	2,693	X	4,292	6,592	X	4,327	5,597	4,892	4,843	2,265	2,731	3,362	2,743	4,112	3,441	2,140	5,173
	Percent homes owner occupied	87.0	X	84.7	85.5	X	74.1	75.2	X	90.2	85.9	96.0	68.7	58.7	78.7	91.8	78.9	82.0	16.6	60.6	51.2
	Percent population over 5 years age living in same house as 1995	77.0	X	66.1	65.3	X	66.0	61.6	X	69.7	75.0	73.8	63.8	61.7	71.0	76.0	64.6	70.0	26.7	67.8	53.3
2010	Population	X	X	4,138	1,780	368	2,612	3,681	X	1,612	2,773	2,541	3,003	1,356	1,282	1,241	925	2,196	1,474	1,517	3,398
	Percent homes owner occupied	X	X	88.5	84.7	85.7	68.1	72.8	X	83.4	72.7	88.8	78.3	56.6	65.3	82.6	51.3	66.9	9.2	55.5	41.6
	Percent of population more than 5 years in same house	X	X	54.3	17.1	50.4	42.5	41.3	X	47.5	41.4	36.0	44.4	32.5	26.9	32.5	19.5	32.1	7.1	49.8	28.4

Buras-Triumph-Venice (505 and 507) and greater in the more rural tracts (506 and 508). The percentages of homes that are owner occupied continued to be exceptionally high by U.S. and state standards in all but one tract (503). The percentage of residents living in the same homes as 5 years previously shows some variability over time, with relatively high levels in 2000 and markedly lower levels in 2010, possibly reflecting the disruptive impacts of Hurricane Katrina. Data from the 2000 Census show that roughly half of all Plaquemines Parish residents who had lived in a different house in 1995 moved within the Parish (U.S. Census Bureau 2000). Due to a change in questions asked during the 2010 Census, data on 5-year mobility were not collected. Such data on mobility in the future will be reported in the American Community Survey (ACS). The ACS (2010) reported that for the period 2006–2010 the majority of residents who had recently moved had moved from one home in Plaquemines Parish to another.

Population Change in St. Bernard Parish

Like Plaquemines Parish, St. Bernard Parish covers an enormous area, much of it submerged. Census tract 301.01 covers the Chandeleur Islands as well as the wetlands area surrounding Lake Borgne. For 2010 the Census Bureau eliminated Census Tract 301.01, an unusual step considering that these units of analysis are designed to be relatively stable over time. Tract 301.02 had been eliminated in the 2000 Census, as had 302.05. Two new census tracts were established for the 2000 Census (302.08 and 302.09) and one new tract was established in 2010 (301.04). These changes complicate population comparisons between the decennial censuses. Table 5 shows that parish-wide data mask important local differences. With the exception of one census tract (306.03), St. Bernard Parish can be characterized as having an extraordinarily high percentage of residents that live in owner-occupied homes. Data from 1990 and 2000 reflect community stability and personal investment in homes.

Census data from 2010 reflect far lower percentages of people living in the same homes as 5 years previously when compared to previous census periods (Table 5; Figure 2). As was the case in Plaquemines Parish, more than half of all St. Bernard Parish residents living in a different house in 2010 than in 2006 had moved from one house to another within the same parish (American Community Survey 2010; Table S0701). A similar pattern is found in the 2000 Census data comparing residence in 2000 and 1995.

The data presented here show that residents of coastal parishes in Louisiana generally, and in both Plaquemines and St. Bernard parishes in particular, have been heavily invested in their communities. The data also show patterns of steady population loss in census tracts that are most vulnerable to storms due to land subsidence, sea level rise and coastal erosion. Where growth has occurred, it has been in those census tracts further from the coast. We believe these data reflect a gradual retreat from the coast with coastal residents moving relatively short distances that provide additional protection from storms but allow for continuation of their traditional coastal occupations and social networks.

Pathways Forward

These census data give us a glimpse of the outcome of decisions made to date by individuals and families about where to live along the Louisiana coast. In this section we delve into the framing of these decisions, both ones already accomplished and those contemplated. These fall into four categories:

Staying in Place but With Major Structural/ Spatial/Physical Community Changes

The creation of significantly reconfigured communities surrounded by storm surge barriers has been suggested as a way to retain the current location of threatened communities. An example that is in active discussion is the *localized* structural solution to the threatened community of Jean Lafitte with the surrounding villages of Lafitte, Barataria and Crown Point. Hurricanes Rita (2005), Lee (2011) and Isaac (2012) poured storm surge into this area in amounts and levels of destructiveness not experienced in recent times. Coastal land loss as well as the slow forward speed of these storms are the attributed causes of the destruction they caused. When the prospect of creating a full regional levee was dropped recently by the U.S. Army Corps of Engineers due to the costs of the post-Katrina levee construction standards and the concerns of the negative impact of such construction on the ecosystem, the Corps proposed creating a ring levee system (flood wall) around the most densely inhabited parts of the area. This project may also be threatened by the dropping of the larger project but local and state efforts are going forward in an attempt to save the localized structural solution.

The challenges of a ring levee are enormous. How high must it be to prevent water from surging over the walls and filling the bowl? How large must the pumping system be and how will it be powered to evacuate water that enters via rainfall and possible overtopping? How close will the wall be to existing homes and businesses? Will it act as a barrier to normal community dynamics? How many openings through the ring levee should be constructed to permit the flow of marine activity, especially the fishing boats of local harvesters given the cost of each opening? Post Hurricane Isaac, Mayor Tim

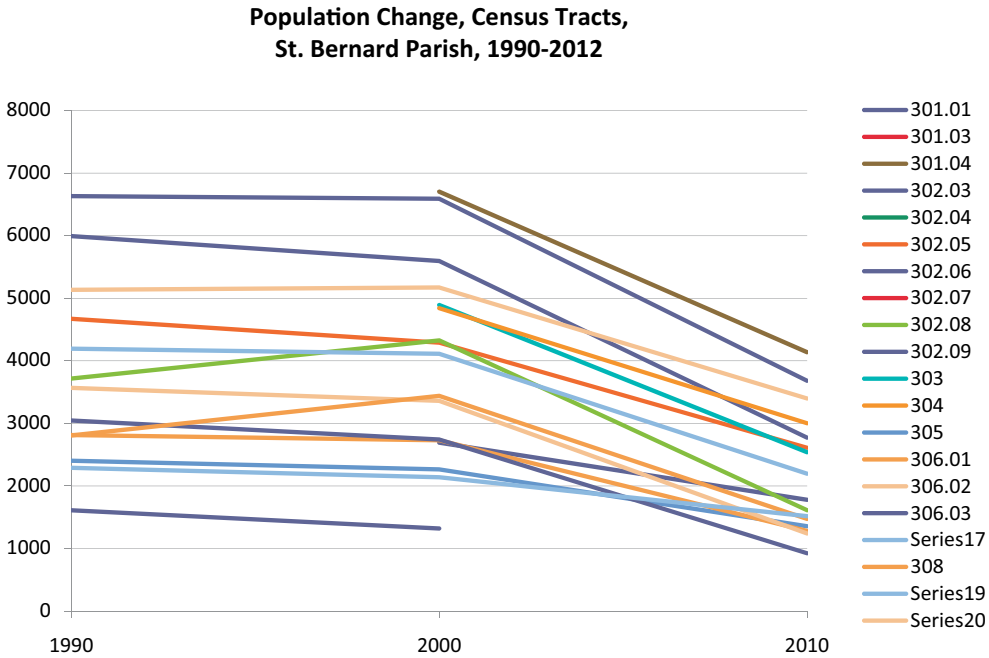

Fig. 2 Population Change, census tracts, St. Bernard Parish, 1990–2012. For references, see Table 5.

Kerner suggested that a 10-ft ring levee would cost about $ 300 million, one third of the proposed higher levee.[1]

In addition, community planning meetings supported by funding from the Louisiana Coastal Protection and Restoration Authority (CPRA) to the Center for Planning Excellence (C-PEX) in Baton Rouge[2] included discussions of ways in which more residences could be constructed *within* the proposed footprint of the ring levee to accommodate some of the residents who live south of the town who have expressed an interest in relocating to the protected area. Since the idea was proposed a couple of years ago, community leaders and residents have regularly articulated concerns for such an adaptation. Can a community function within such 'confinement'? If the 'commons' area in the community is occupied by more housing, will the community lose the opportunity to have the space be used for public and commercial activities?[3] Will residents feel that the original sense of the community is violated by such mixed use of the town's center? Smart growth ideas that combine residential and commercial in close density have been proposed but received mixed responses.

Another community risk reduction idea is taken from the nineteenth century Manila Village Filipino shrimp drying community that lived on platforms nearby.[4] Such elevated walkways might be a very innovative approach that could add historic linkage to the area. These efforts might be combined with the ring levee to provide more risk management. Community and parish leaders drew national attention to the floodwall solution after tropical storm Lee in September 2011 and again after hurricane Isaac in September 2012.

In an effort that also contributes to this discussion of community reconfiguration and encapsulation, coastal ecologist John Day and Jeff Carney, a landscape architect at LSU and Director of the LSU Coastal Sustainability Studio, prepared a white paper demonstrating a plan to encapsulate a small fishing community in T-walls and earthen levees.[5] The difference between the proposal and the Jean Lafitte experience is that the community's existing footprint would be significantly reconfigured, a challenging prospect. There would have to be a community-wide agreement and some land/home owners would have to give up their ownership in exchange for a new location on land currently owned by someone else. Some of these lands have been handed down within families for five generations and contain mineral rights. While it might be possible to accomplish such protection for a small community like Yscloskey in lower St. Bernard, albeit at a very high financial cost, the negotiations necessary to accomplish it for larger communities would be time consuming, and very challenging, thus likely not accomplished within the existing time frame that these communities have left.

In addition, the linear configuration of coastal Louisiana communities along the natural levees of historic Mississippi River paths on the deltaic plain in eastern Louisiana and the cheniers in western Louisiana does not make them "eligible" for such an encapsulating solution. Settlement patterns that

[1] Channel 8 (Fox) television, Sept 7, 2010.

[2] Project Supervisor, Camille Manning-Broome, Director of Planning, Center for Planning Excellence (CPEX) Baton Rouge, LA.

[3] Personal communication with Ms. Manning-Broome. Concerns of Jean Lafitte Mayor Tim Kerner.

[4] http://philipppines.tripod.com/reggie/manilav.html Accessed 8 July 2012.

[5] Unpublished white paper shared with the chapter authors.

historically followed linear patterns have been reinforced over time as growing populations and infrastructure to support them have developed on this high ground. Despite these challenges, given the risk the communities on the very coastal edge face, it is likely that conversations about these possible local major structural community changes will continue to be broached, refined and promoted for implementation for the small number of settlements for which it might work.

In Place Response of Adaptation/Mitigation/Non-Structural[6]

For coastal Louisiana community residents and leaders, in-place risk reduction is their choice response but with the caveat of not wanting to have government controls placed on private property. Norris-Raynbird (2011) found the least desired method of reducing risk was relocation, but the next least desirable is land use regulations. This is a very serious position the communities are taking because it suggests that the degree of risk seen by the outside advocates of zoning is not perceived by the residents and leaders of the communities as being grave enough that they are willing to compromise land use decisions. "You mean take the property out of commerce?" is one phrase that emerges when land use control is proposed that would prevent development because of flood risk.

Given that the support services and businesses for the offshore oil industry desire to be as close to the Gulf as possible, the location of such businesses in the coastal parts of the parishes may continue despite their risk; Port Fourchon at the tip of Lafourche Parish is certainly such a case. Similar to fishers wanting to remain close to their harvesting grounds, so too oil-production businesses want to locate near the offshore activity they are supporting. Additionally, nationally, little interest has been expressed by businesses to mitigate commercial structures; rather businesses frequently opt to absorb the loss when a flood occurs.[7] Businesses, including in coastal Louisiana, feel that adjustment to the property or building that blocks business conducted the usual way will reduce profits.

It may be also that the community leaders do not believe that asking owners to give up control would be an effective measure of risk reduction even if they agreed to do so, and that the tradeoff might be economic stagnation, a similarly high risk. More research is needed to determine whether risk reduction is negative or positive in its relationship to total community resiliency and specifically to economic activities. That may give homeowners' and officials' needed knowledge to know if their resistance to methods used in larger communities, that are so strongly advocated by planning and mitigation practitioners and their organizations such as the American Planning Association and Association of State Floodplain Managers, to name two nationally important ones, is in their communities', and their businesses' self interest.[8]

The University of Louisiana at Lafayette has studied one very successful case of mitigation—through voluntary home elevation. The town of Delcambre in Iberia/Vermillion Parishes has been very successful in their efforts (Farris et al. 2010). Following Hurricane Rita there initially was little support for elevating homes, but slowly that began to change. After Hurricane Ike, residents began to realize that a 1-in-100 year storm (which is what Rita was called) meant that there was a 1% chance for such a storm *each year*, not that it would be 100 years before another came along. UL-Lafayette sociologists associated with the Center for Socioeconomic Research conducted a survey of all houses in Delcambre in June of 2009. Over 40% of the 850 houses were elevated above Hurricane Rita's surge then and they estimate that over 50% are now elevated. People who have not elevated told the researchers that they "are on the list."

The success of Delcambre's elevation 'movement' began during earlier storms when the community's Economic Development Committee took the lead in promoting elevation and benefitted from the advice of a well-respected mitigation specialist and LSU Sea Grant official. The ensuing storms prompted increasing interest by the residents in what Economic Development officials had promoted. Improvements in efforts to mitigate over multiple flooding events, what is demonstrated in Delcambre, was first observed in the Pearl River subdivisions in Slidell where self-mitigation of homes (no government funding) to increasing protection occurred over several flooding incidents as the earlier efforts showed some success (Laska 1990).

Elevating existing houses in Delcambre cost between $ 10,000 and $ 50,000 apiece. Looking, for example, at Yscloskey in eastern St. Bernard Parish, even starting from scratch and if each new elevated house cost $ 150,000 and if there were 100 of them, that is $ 15,000,000 total, an amount probably less than half the cost of a single floodgate that would be part of the structural strategy (# 1) above. And elevation of commercial and public buildings is of course also possible (see below). Similar rates of home elevation are occurring in southern Terrebonne parish and on Grand Isle. Unfortunately in the latter case the community was refused

[6] In the jargon of the U.S. Army Corps of Engineers "non-structural" mitigation means any strategy that does not involve large levees, i.e. 'structures'.

[7] Personal communication with Gene Barr, retired U.S. Army Corps of Engineers member of the National Non-Structural Committee. Sept 7, 2012.

[8] Hazards Planning Research Center, Am. Planning Assoc. www.planning.org/nationalcenters/hazards/ and Association of State Floodplain Managers www.floods.org.

funding to repair a breached levee because their elevation efforts had reduced the benefit/cost ratio needed to have the levee supported. Hurricane Isaac targeted Grand Isle and the island was overtopped with 2–5 feet of water. Such an approach toward funding by the Corps—not rewarding elevation but rather considering it contrary to proposals for levee repair—prompts consternation among communities who want to reduce their risk as much as possible: If you elevate effectively behind levees, you might reduce your prospects of retaining federal support to maintain the levees you have.

A more detailed consideration of the combination of multiple methods is warranted. For example, currently no Corps flood protection projects have ever included project 'alternatives' (phrase used to describe various proposed flooding solutions from which the Corps will select one for construction) that combine the two types in one flood risk reduction project.[9] This fact may reduce the willingness of those behind levees, even those behind levees providing less than 1 %/year. protection, to elevate if they fear reduction in levee maintenance if they elevate or do other risk reduction efforts. Erring on the side of redundant risk reduction, as in the "multiple lines of defense" approach is a paradigm shift not yet experienced by government programs and resources, the Community Rating System being an exception. For this program, efforts on multiple measures combine to reduce the cost of flood insurance for an entire participating community. (See below for more details of this program.)

Elevating homes does not, however, protect boats and other community infrastructures. Some community and commercial infrastructure elements can also be elevated. See South Cameron High School, Bridge Side Marina at Grand Isle and Capital One Bank at Cameron for examples. In coastal resource dependent communities boats are the lifeblood of resource harvest and are, thus, a special consideration when mitigation and restoration strategies are considered. It is not uncommon for the boat to be worth more, financially, than the family's home and a common practice is for some family members, usually the men, to evacuate the boat to a more protected anchorage as a hurricane approaches. Wind, rising water, and waves are the threatening forces that tropical storms bring. Boats are usually designed to take a considerable amount of wind and they can float above rising water as long as they can be secured in place and be protected from waves and harm from other boats that have broken loose. Docks that float and thus also rise and fall with the water are common in areas with high tidal ranges and some combination of floating docks, protective anchorages, or systematic, well thought out, evacuation plans for vessels is in some cases as important as a mitigation plan for homes and businesses.

The crossing of the bayous with new bridges, however, prevents the boats from being moved inland as easily as in the past. In addition, surge barriers in bayous or over coastal highways, unless carefully thought out, can also prevent harvesters from securing their boats and equipment. Lafourche Parish built a lock at their surge barrier in Golden Meadow in order to permit boats to enter the safe bayou after the gate is closed behind them. The combination of raised structures and protected havens for boats may offer the best response to both climate and energy challenges. But again, they may be difficult to create with the bayou linear water patterns and extreme loss of land on the coast.

The other means of reducing risk that Norris-Raynbird (2011) studied and that are included in John Lopez's "multiple lines of defense" include: citizen mitigation education, local building code reform for both new and existing construction above the state minimum and wetland restoration projects (Lopez 2006). Several coastal parish leaders (St. Bernard, Terrebonne and Jefferson Parishes are three of them) have acknowledged that higher elevation levels as part of the building codes have mitigated flooding during Hurricane Isaac. These multiple lines of defense were all seen as favorable, i.e. in the middle range of support in Norris-Raynbird's (2011) study. Of course, levees in the locations where they currently exist were also very popular selections.

Our recommendation is that SEST be supportive of communities in determining what they want to do with regard to reducing risk, supporting their knowledge and resources to do so. The 'edge' of this recommendation is that more detailed representations of the worst-case scenarios should be included in the possible models of action. Both the risks and the solutions should be moved from the 'abstract' to the 'real', i.e., best practices. When considering coastal restoration as the prime means of risk reduction we believe that restoration cannot be the focus at the expense of considerations of mitigation. *Restoration and mitigation should be integrated and should not proceed independently nor linearly, i.e. restoration first.* And, we should not minimize the implications of climate and energy threats. These should be clearly presented to coastal residents and others so that fully informed decisions can be made.

FEMA's efforts to be the 'regulator' for risk reduction have achieved mixed results. Mandating elevation in flood zones for example was given a middle approval rating by the interviewed officials in the Norris-Raynbird study, but also resisted—most Louisiana coastal parishes appealed the new National Flood Insurance Program flood maps. Norris-Raynbird found that there was a decline after hurricanes Katrina, Rita Gustav and Ike in willingness to enforce coastal zone requirements already in place and/or being strength-

[9] Personal communication with Gene Barr. Some efforts have been made to consider non structural alternatives but not in conjunction *with* non structural. Nov 16, 2012.

ened by federal agencies. It might have been expected that stricter regulations would have been received in a positive manner as risk reducing actions. However, the fear that the regulations will increase costs to the extent that they will reduce their communities' ability to continue to exist, turn the regulations into enemies rather than resiliency support. The new regulations changed coastal officials' views from seeing themselves as "regulators" to seeing themselves as being "regulated." This response likely came from the frustration due to limitations placed on the rebuilding process after the storms. Revisions (most often expansion) of the flood maps which determine who must purchase flood insurance and how much it will cost combined with the level to which structures must be elevated in risky areas were major points of concern observed by Norris-Raynbird.

One FEMA National Flood Insurance Program effort–the Community Rating System—is a regulator approach but with a twist. It rewards risk reduction behavior by reducing flood insurance premiums community wide if the community adopts certain risk reduction methods. Several coastal parishes and cities hold the best ratings in the state—Terrebonne, Jefferson, St. James and St. Tammany Parishes and Houma, Kenner and Mandeville (Federal Emergency Management Agency n.d.).[10] Some concern by national officials that the requirements were not strong enough has led to revisions that are requiring parishes to improve their efforts. Terrebonne is trying to anticipate these new requirements so as to retain a good Community Rating System level.[11] Such an approach as the Community Rating System—rewarding good practices—is a possibility for bringing local officials on board. Funded mandates are another possibility of achieving risk reduction activity compliance. It is the unfunded mandates that cause the most resistance.[12]

Long Commutes for Harvesters and Seasonal Use of the Coast

Separating fishers' residences from their boats increases their cost of operation and the greater the separation the greater the cost. Not only are commutes expensive (fuel, vehicle wear, time lost fishing), but also the new cost of renting a berth in a marina is an additional burden.[13] Currently many coastal fishers live on the bayou and literally tie up their boats in their back yards. In addition, the complex networks of exchange and support (see below in #4) would be degraded or lost with this option. Pre-Katrina research funded by the Louisiana Coastal Area program examined the space around ecosystems that was important for harvesters and communities, in other words the ecosystem that must be protected to preserve the existing community and harvesting social structure (Laska et al. 2005). Reviewing what would be lost with continual storm inundation leads to the conclusion that it may be very difficult to relocate harvesters inland very far and still have them continue to harvest (see also Gramling and Hagelman 2005).[14]

As long-time coastal residents have left, new people have come to dominate the coastal landscape in some parts of Louisiana, leading to gentrification of the coast by recreational fishers building new, more storm-resistant camps than the older homes owned by permanent residents. *Gentrification* is a term usually used in reference to patterns of urban development where people purchase inner-city properties that are in decline and develop these into attractive housing and retail destinations displacing the resident population which cannot afford higher rents in the newly desirable locations (Laska and Spain 1980). The same process of displacement is occurring on Louisiana's coast. The new structures, sometimes in "gated" communities tend to be separated from the original residents. While the owners are not included in the population counts, their investment in places like Cocodrie and Bayou Dularge in Terrebonne and Grand Isle in Jefferson Parish are quite evident.

These new investments place new demands on local and state governments, focusing on the needs of weekend and vacation visitors and diminishing the broad community dynamics of local schools, religious organizations, commercial resource extraction activities, and local retailers that supported these activities. Gentrified communities are not a substitute for "comprehensive" small communities that serve permanent residents across a range of economic incomes and occupations. Some would say that no longer are they communities but rather have become 'locations' for temporary activities. Original residents must shift their economic activities to serve the vacationers' interests and worry about how they will satisfy their other needs such as schools for their children as the permanent resident population declines.

An example of such coastal development is the recent creation of the Queen Bess gated community on Grand Isle that was carved out of the marsh on the bay side of the island contiguous to the tract preserved by the Nature Conser-

[10] East Baton Rouge and Shreveport are the inland exceptions.

[11] Personal communication, Chris Pulaski, Senior Planner, Terrebonne Parish Government. Sept 7, 2012.

[12] Personal communication, Camille Manning-Broome, Director of Planning, Center for Planning Excellence. Sept 6, 2012.

[13] Several shrimp, finfish and crab harvesters participating in the large GoFish anti-BP rally (August 2012, Alario Center, Jefferson Parish) spoke of the exhaustion they experience because they are no longer able to live near where they harvest due to loss of homes from storms or inability to pay house mortgages.

[14] Recent collaborations by UNO-CHART with the Barataria Bay shrimp, oyster, crab and finfish harvesters through CPRA funding (SciTEK Project) showed very few of them lived outside of the Barataria area, even though both sides of the Bay were badly damaged during the last seven years. Of the 13 harvesters in the project, only 1/13 keeps their boat at a marina and 3/13 commutes down to their boat from farther inland.

vancy for songbird arrival each spring from across the Gulf of Mexico. Residents express concern that the canals dug for the private boats will act as channels to put more water on the island during storms. There is no doubt that the development reduces the area for songbird usage, with its accompanying economic activity—the Grand Isle Bird Festival—that has brought financial benefits and nationwide kudos for the area's and the state's commitment to the environment.

Relocation

Relocation of populations and communities has many manifestations. The moves documented in the census data in the first section of this chapter are moves of individuals, households of various configurations and perhaps multiple extended family households, close friends or neighbors to the same areas But willingness to move is not common in coastal Louisiana as the Census data in the first section of this chapter demonstrates. Geographic and cultural differences have created more change-resistant and "attached" communities in the wetland and riverine areas of Louisiana than perhaps in the beach communities of say the northern Gulf of Mexico, where many residents have already moved inland after Katrina. To the extent that members of communities on a beach coast already focused on a tourism culture can move inland and still participate in the pre-Katrina tourism economy, the relocation might be less disruptive. While community ties, neighbor and extended family social capital will still be fractured, these tourist-oriented activities are much more focused on the money economy and are not as dependent on complex networks of exchange and support as are the resource dependent communities embedded in the Louisiana coastal wetlands. In addition, because of the population distribution patterns and transportation routes along narrow fingers of remnants of the Mississippi River path created thousands of years ago, relocation involves much longer distances to "safe" areas in Louisiana than inland from the straight Mississippi and Alabama beach-lined coast. No comparison of difficulty is meant here. All relocation is very difficult—disruptive, costly both socially and economically as will be outlined below. But community differences create different challenges for individual and households in their struggle to remain in a risky location or to relocate.

Individual and household relocation has also occurred in coastal Louisiana under dramatically harmful conditions to those who have been 'forced' to relocate, called *involuntary relocation*. One dramatic example is the post Katrina diaspora from New Orleans. The population of New Orleans has been reduced by more than 100,000 since Hurricane Katrina (Table 1), even considering in-migrants to the city after Katrina. Some original residents were evacuated to locations far away and have been unable to return for economic reasons. Related contributing factors are the demolition of most public housing after the storm and housing costs increasing dramatically. It should be emphasized that such relocation is the result of the magnitude of the event and damage but perhaps more so the lack of 'essential resiliency' of the community (Laska 2012). Essential resiliency is the pre-event condition of the entire community and its citizens with regard to available employment appropriate to resident skills/education, social justice commitment (thus trust among groups and of the government), strong social and public service provision and other community characteristics that reflect a community successfully supporting the well being of *all* of its residents prior to a disaster happening. Future major disasters in the region will produce continuing involuntary migration of both urban and rural populations to the extent that essential resiliency is not achieved.

In the case of such involuntary relocation strong tensions exist between working toward removing residents, their homes and belongings from harms' way and supporting a relocation experience that in itself does not harm the migrants. Noted work by Michael Cernea (1997) clearly describes the outcomes of relocation without careful, resourced relocation efforts: landlessness, joblessness, homelessness, marginalization, food insecurity, loss of access to common property resources, increased morbidity and community disarticulation. The latter refers to the fracturing of social networks and social systems critical to individual, household and community resiliency.

Some groups will fare better than others by virtue of their economic resources and involvement in the modern sector of the economy, i.e. more mobile employment skills. One such group comes from suburban communities of middle-income residents, some of whom migrated here from other locations and then will relocate away. Such migrants are more similar to the migrants who might move from one city to another for employment purposes. The move may be less challenging for them because they are less attached to place. The economic contribution such individuals can make to the region is, nonetheless, important and thus a loss if they must migrate. Among such migrants after Katrina are African American professionals from New Orleans East, whose loss to New Orleans is more than just economic.

The third type of relocation of individuals or households is somewhat unusual and includes multiple extended family households, multiple individual close friends or multiple neighbors, either individuals or households. Such group behavior is not common. It is, however, documented in the movement of residents of St. Bernard Parish to St. Tammany Parish after Hurricane Katrina (Lasley 2012). Multiple extended families, close friends or neighbors have moved into the same new residential subdivisions. The linkage is by word of mouth recommendations for particular contractor/developers and for subdivisions of affordable, right-sized homes with desired amenities such as nearby social institutions with linkages to the original parish—churches, schools,

butchers, restaurants. The mutual attachment of former St. Bernard residents to one another and their 'migrated' social institutions has played a significant role in this form of relocation. No formal organizations or government activities have caused these relocations to similar destinations. Social networks including social clubs have supported the moves as they have happened.

Another option is to relocate entire community populations (we are coining the term *en group* to describe this form of relocation) to more protected locations, as intact communities. The Louisiana coastal Native American communities at risk to flooding and storm damage have expressed this desire if they have to relocate. Such relocation will permit the continuation of the close social functional ties with other community members and the continuation of cultural practices both of which form the core of the resiliency of such groups.

Our society has little experience with *en group* relocation except as short "up-the-hill" relocations such as the one that occurred with Valmeyer, Illinois moving onto the higher bluffs after the Mississippi River flood of 1993 (Knobloch 2005)[15] and the classic example of the Tug Fork, West Virginia relocation (U.S. Army Corps of Engineers 1984). There appear to be a number of obstacles to achieving such relocation. Not the least of these problems is current land and mineral ownership patterns that in some cases have been established for generations. Cultural and sacred meaning of the current locations of the community places also comes into play. Initiating the complicated process that would be necessary to accomplish such *en group* relocation seems daunting given that few government tools are available and the lack of motivation of state and federal agencies to create such tools. In addition Norris-Raynbird (2011) found little support for this strategy among local officials. Finally, another factor that also enters into the consideration is the resistance by those communities already established farther inland to the increased population density brought on by relocation.[16] There may even be ethnic-group resistance by the receiving communities to such inland migration of some groups such as Native American communities,[17]

Social networks linked to traditional economic activities are fundamental to a way of life in Louisiana coastal communities. Coastal residents engage in a complex set of relationships that combine the social with the economic in webs of support that make many economic activities possible and important. As coastal land loss and repeated storm impacts break up communities and force individuals and families to migrate inland they lose not only the place they were familiar with, but the network of exchange that sustained them, and as a result their new lives, while "safer," are poorer for the loss of place. Their subsistence livelihood fits the "commons" of the marsh, bays and near-edge coastal waters; it cannot function inland.

Additionally, the loss of population in the small communities puts those remaining at risk because of the decrease of people in their social networks.[18] Dennis Mileti's research (1997) on decision-making before a disaster, called researching or 'milling' (in later evolution of the research) finds residents checking facts and beliefs among a family/friends network when deciding whether to evacuate or not. These same dynamics of 'sense making' occur in the recovery phase, according to DeRouen et al. (in press). As community size declines, residents have fewer friends, neighbors and co-workers with whom to interact to make good decisions including those choices of whether to remain or leave.

The state of Louisiana had federal resources after Katrina/Rita that several environmental groups and a university argued could have been used for a relocation of one of the largest most at risk groups, the United Houma Nation, but to no avail. The leaders of another at risk Native American group—the Isle de Jean Charles now hope that they will be able to benefit from the funds resulting from the British Petroleum (BP) oil spill—NRDA or EPA Water Quality fines from BP to accomplish this outcome. The only option currently available for community members is to relocate individually or as households, thus separating them from their resource extraction activities and traditional Native American culture. We know what happened to Native Americans in the twentieth century who were forced from their land into impersonal urban settings. The Cernea work (1997) described above and in multiple other publications, clearly warns of the negative outcomes whether it be for rural Native Americans, for urban African Americans or for those coastal residents in general, regardless of race or ethnicity with limited economic resources and attachment to coastal occupations. To date, the society has declared through the actions of the federal and state bureaucracies that it cannot, will not, use its resources to affect successful community (*en group*) relocation within coastal Louisiana. The future on this option is yet to be written.

Discussion

With some exceptions, coastal restoration efforts will not force people from their communities. Modeling of water levels has shown that Jean Lafitte in Barataria Bay would have problems if the existing diversion from Davis Pond were to fully flow at the same time as the proposed Myrtle Grove diversion, i.e. during the spring high water. Inunda-

[15] http://freshstart.ncat.org/case/valmeyer.htm.

[16] Personal communication with JoAnne DeRouen, University of Louisiana at Lafayette regarding findings from post Hurricane Rita research.

[17] Personal communication with Albert Naquin, Chief, Isle de Jean Charles Band of Biloxi-Chitimacha-Choctaw Indians.

[18] Personal communication with JoAnne DeRouen, *ibid*.

tion of existing communities' structures was also a concern of the Third Delta Conveyance Channel proposed to deliver fresh water and sediment on either side of Bayou Lafourche (Gramling et al. 2006). (This proposal never moved forward from the study phase.) And in some proposed restoration plans, the shift of salinity that results from introduction of freshwater will affect the location of the harvesting they do, such as oysters, and thus limit the economic usefulness of living at certain sites. For most coastal communities, however, lack of restoration coupled with lack of mitigation of natural and technological hazards will be what forces people away from the coast. Thus, both restoration and mitigation, *which should always be conducted in a coordinated fashion*, are positive activities for coastal communities.

Conclusions

Coastal Louisiana is facing a perfect storm of subsidence, climate change, sea level rise, rising energy prices, and financial constraints on governments. Some areas will be lost. Others may be able to survive, at least for a while. As the most adaptive species on the planet, people and communities will take actions, make choices, and will do so based on knowledge of place and commitment to community. Key national mitigation experts (Natural Hazard Mitigation Association[19]) meeting during the summer of 2012 at the University of Colorado's highly respected Natural Hazards Workshop, affirm the approach developed by James Lee Witt, when he was director of FEMA, entitled "Project Impact"—oriented toward encouraging internal community support for risk awareness and risk reduction response, utilizing the communities' own social capital. The serious question for applied social scientists concerned with coastal Louisiana is this: can the local communities make a commitment to comprehensive non structural adaptive mitigation fast enough to keep up with the increasing risk to which they are subject? And can applied social and physical scientists make a contribution to this achievement? As stated above, scientists should clearly present the full range of challenges facing the coast, including climate and energy scenarios, and best practices for non structural/ mitigation/ adaptation methods so that informed decisions can be made. The 'window' for learning about the threat and for appropriate responses is closing rapidly due to the escalating pace of increased risk.

We need to explain the likely impact of climate change and sea level rise on specific communities. We need to explain the problems with relying exclusively on a structural approach to coastal protection, including high and recurring operation costs that may not be sustainable politically or otherwise. Without a realistic and overarching appreciation of the changes that are occurring to the ecosystem it may be that the protective actions that are taken have the effect of increasing risk. Constructions of elaborate levee systems are likely to encourage further investments behind those levees in homes and businesses that will be at risk *when* the levee systems fail. Coastal policies designed to confront rather than work with natural deltaic forces may send the wrong message to coastal residents, that it is safe to stay rather than continue the process of gradual retreat from the most vulnerable parts of the Louisiana coast.

As scientists concerned with human adaptation to change, we believe it is also necessary to focus attention on issues of public policy including its implementation, and in particular identify those parts of public policy that undermine the ability of coastal communities to have a voice in their futures, or result in investments that favor one set of actors (e.g., recreational or navigation interests) over another (historied communities). Our role as scientists is to clearly and honestly present information on climate, energy, ecosystem dynamics, human social system processes and large economic forces, that may make certain community resiliency options much more difficult, if not impossible, within current planning horizons. Our role should not be to tell communities what they must do, but to help them explore and implement risk-reducing options in as timely a manner as possible.

[19] National Hazard Mitigation Association http://nhma.info.

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