3.11 – Extreme Heat Hazard Profile

The extreme heat hazard in New York State is often underestimated because other natural hazards occur more frequently (e.g., floods, tornadoes, hurricanes) and its effects can vary based on region and vulnerable population within the State. The Mitigation Plan Development Team researched the extreme heat hazard as it affects the State. Contents of this section result from research and outreach including the following sources:

- New York State Emergency Management Office, *New York State Comprehensive Emergency Management Plan Vol. II*
- National Weather Service, www.nws.noaa.gov/om//brochures/heat_wave.sthm
- Federal Emergency Management Agency, www.fema.gov/hazard/heat/heat_before.shtm
- New York City Office of Emergency Management, *New York City Heat Emergency Plan*
- City of Long Beach New York, http://www.longbeachny.org/index.asp?Type=B_BASIC&SEC=%7BF277C090-D853-4DA5-A92C-8D99AFB90965%7D
- National Climatic and Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
- State of California, *2007 Multi-Hazard Mitigation Plan*

The following chart provides the definition of an extreme event:

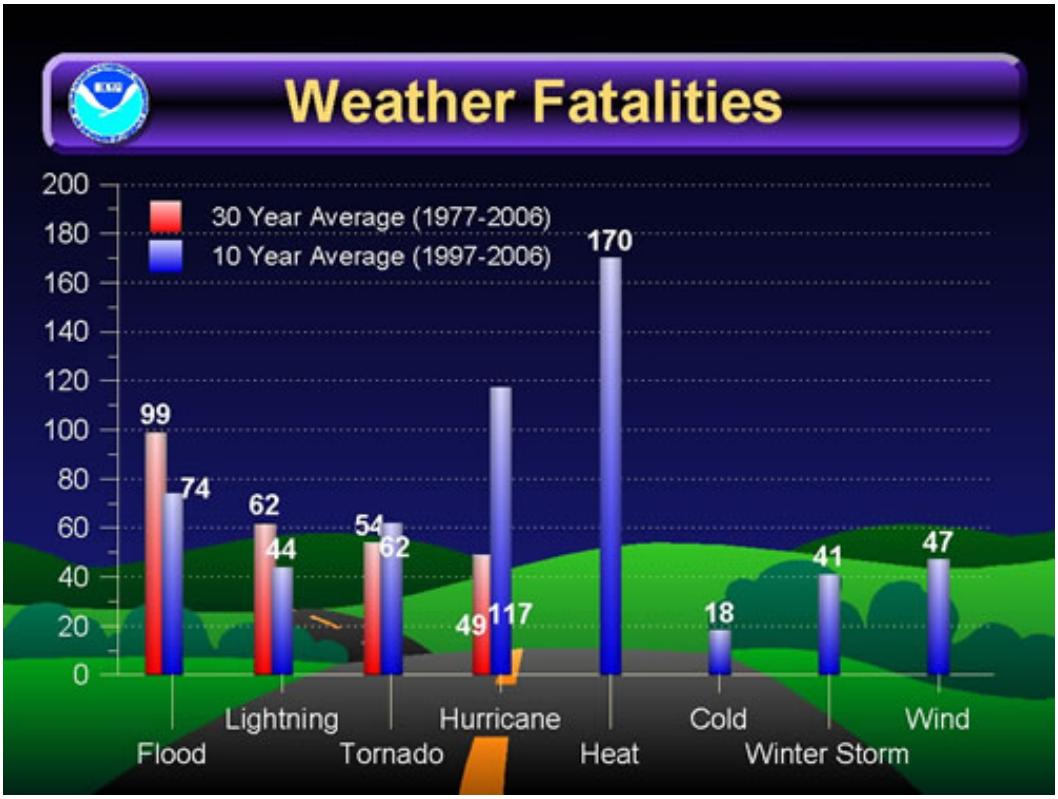
Term	Definition
Extreme Heat	Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility. Droughts occur when a long period passes without substantial rainfall. A heat wave combined with a drought is a very dangerous situation.

The Concept of Extreme Heat

Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and last for several weeks, and though the event may not be as notable as other hazards which affect NYS, its effects can have devastating consequences. While it is hard to quantify the exact total number of deaths which are advanced by heat wave weather, in a normal year, about 170 Americans succumb to the demands of summer heat. Its annual fatality potential is matched by no other natural hazard which is profiled by NYS (**See Figure 3-121**). In

a 40-year period from 1936 – 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the disastrous heat wave of 1980, more than 1,250 people died as a result of extreme heat. In terms of New York State, from 1994 – 2006 there have been 86 fatalities as a result of extreme heat. 79 of the 86 fatalities took place in a period of 7 years, ranging from 1999 - 2006.

Figure 3-121
Weather Fatalities



**Source: National Weather Service.*

Heat Index

Created by the National Weather Service, **Figure 3-122**, the Heat Index (HI), is a chart which accurately measures apparent temperature of the air as it increases with the relative humidity. The Heat Index can be used to determine what effects the temperature and humidity can have on the population. **Table 3-49** describes the adverse effects that prolonged exposures can have on individuals. To determine the Heat Index, you need the temperature and the relative humidity. Once both values are known, the Heat Index will be the corresponding number with both values. That number provides how it really feels. It is important to know that the Heat Index (HI) values are devised for shady, light wind conditions. Exposure to full sunshine can increase HI values by up to 15 degrees. Also, strong winds, particularly with very hot, dry-air can be extremely hazardous to individuals.

Figure 3-122
Accurate measurement of temperature during an extreme heat event

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution Extreme Caution Danger Extreme Danger

Source: National Weather Service

Table 3-49

Category	Heat Index	Health Hazards
Extreme Danger	**130°F - Higher**	**Heat Stroke/ Sunstroke is likely with continued exposure.**
Danger	**105°F - 129°F**	**Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and /or physical activity.**
Extreme Caution	**90°F - 105°F**	**Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and /or physical activity.**
Caution	**80°F - 90°F**	**Fatigue possible with prolonged exposure and/or physical activity.**

The National Weather Service (NWS) provides alerts when Heat Indices approach hazardous levels. **Table 3-50** provides the alert procedures for the National Weather Service. In the event of an extreme heat advisory, The National Weather Service does the following:

- Include HI values and city forecasts;
- Issue special weather statements including who is most at risk, safety rules for reducing risk, and the extent of the hazard and HI values;
- Provide assistance to State/Local health officials in preparing Civil Emergency Messages in severe heat waves.

Table 3-50

Product	Criteria
Heat Advisory (NYC)	The NWS issues a Heat Advisory within 24 hours of the onset of the following conditions: Heat Index of at least 100°F but less than 105°F for any period of time, or when nighttime lows are above 80°F for any period of time. (Note: This weather product was modified for New York City. The national definition places the heat index requirement at 105°F).
Excessive Heat Watch	The NWS issues an Excessive Heat Watch within 24 to 48 hours of the onset of the following conditions: Heat Index of at least 105ºF for more than 3 hours per day for 2 consecutive days, or a Heat Index of at least 115ºF for any period of time.
Excessive Heat Warning	The NWS issues an Excessive Heat Warning within 24 hours of the onset of the following conditions: Heat Index of at least 105°F for more than 3 hours per day for 2 consecutive days, or a Heat Index of more than 115°F for any time period.

***Source: NYC Heat Emergency Plan**

Health-related ailments

Exposure to excessive heat can pose a number of health risks to individuals. The following is an excerpt from the National Weather service pertaining to the effects of heat on the human body and risks of over exposure. Below the excerpt, **Figure 3-123** defines different health hazards and some of the symptoms associated with extreme heat conditions.

Table 3-51

**Health Hazard	Symptoms
Sunburn	Redness and pain. In severe cases: swelling of skin, blisters, fevers, and headaches.
Dehydration	Excessive thirst, dry lips and slightly dry mucous membranes
Heat Cramps	Painful spasms, usually in muscles of legs and abdomen, and possible heavy sweating
Heat Exhaustion	Heavy sweating; weakness; cold, pale and clammy skin; weak pulse; possible fainting and vomiting
Heat Stroke	High body temperature (104ºF or higher), hot and dry skin, rapid and strong pulse, and possible coma

Source: NYC Heat Emergency Plan, **Refer to 3-49 for corresponding Information regarding heat indices and health hazards.

Figure 3-123

National Weather Service Publications: Heat Wave

How Heat Affects the Body

Human bodies dissipate heat by varying the rate and depth of blood circulation, by losing water through the skin and sweat glands, and-as the last extremity is reached-by panting, when blood is heated above 98.6 degrees. The heart begins to pump more blood, blood vessels dilate to accommodate the increased flow, and the bundles of tiny capillaries threading through the upper layers of skin are put into operation. The body's blood is circulated closer to the skin's surface, and excess heat drains off into the cooler atmosphere. At the same time, water diffuses through the skin as perspiration. The skin handles about 90 percent of the body's heat dissipating function.

Sweating, by itself, does nothing to cool the body, unless the water is removed by evaporation, and high relative humidity retards evaporation. The evaporation process itself works this way: the heat energy required to evaporate the sweat is extracted from the body, thereby cooling it. Under conditions of high temperature (above 90 degrees) and high relative humidity, the body is doing everything it can to maintain 98.6 degrees inside. The heart is pumping a torrent of blood through dilated circulatory vessels; the sweat glands are pouring liquid-including essential dissolved chemicals, like sodium and chloride onto the surface of the skin.

Too Much Heat

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating, or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop.

Ranging in severity, heat disorders share one common feature: the individual has overexposed or over exercised for his age and physical condition in the existing thermal environment.

Sunburn, with its ultraviolet radiation burns, can significantly retard the skin's ability to shed excess heat. Studies indicate that, other things being equal, the severity of heat disorders tend to increase with age-heat cramps in a 17-year-old may be heat exhaustion in someone 40, and heat stroke in a person over 60.

Acclimatization has to do with adjusting sweat-salt concentrations, among other things. The idea is to lose enough water to regulate body temperature, with the least possible chemical disturbance.

Assessment of Local Vulnerability and Potential Loss to Extreme Heat Hazards

Vulnerable Populations

Situational and physical characteristics help to identify vulnerable populations that may not comfortably or safely access and use disaster resources. Specifically, when discussing heat related emergency preparedness, the following groups could be considered vulnerable or at greater risk in a heat emergency:

- Homeless
- Infants and small children under age five
- Women who are pregnant
- Elderly people (age 65 and older)
- Persons who have obesity
- Persons who are bedridden
- Persons with mental illness/disabilities
- Persons with cognitive disorders
- Persons with medical conditions (e.g., heart disease, diabetes, high blood pressure, insulin)
- Persons requiring life-saving medications (e.g., for high blood pressure, depression, insomnia)
- Persons who utilize medical equipment (e.g., ventilators, oxygen, G-tubes)
- Individuals with drug or alcohol addictions
- Persons who use mobility devices (e.g., wheelchairs, walkers, canes)
- Persons who are non-ambulatory
- Those with sensory impairments (blind/visually impaired or deaf/hard of hearing)
- Persons who are under extreme working conditions
- Persons who are poor
- Persons who are socially isolated
- Persons who do not speak English with minimal access to information

The following maps contain a representation of vulnerable population by County. **Figure 3-124** contains information of individuals 65 and older, **Figure 3-125** contains information of individuals 5 and younger, and **Figure 3-126** contains information of both groups combined. These maps contain a broad stroke of information for the Counties. When profiling Extreme Heat, it is incumbent upon Local Municipalities to investigate their Jurisdiction's number of vulnerable population to gain an accurate assessment of the represented age groups.

Figure 3-124

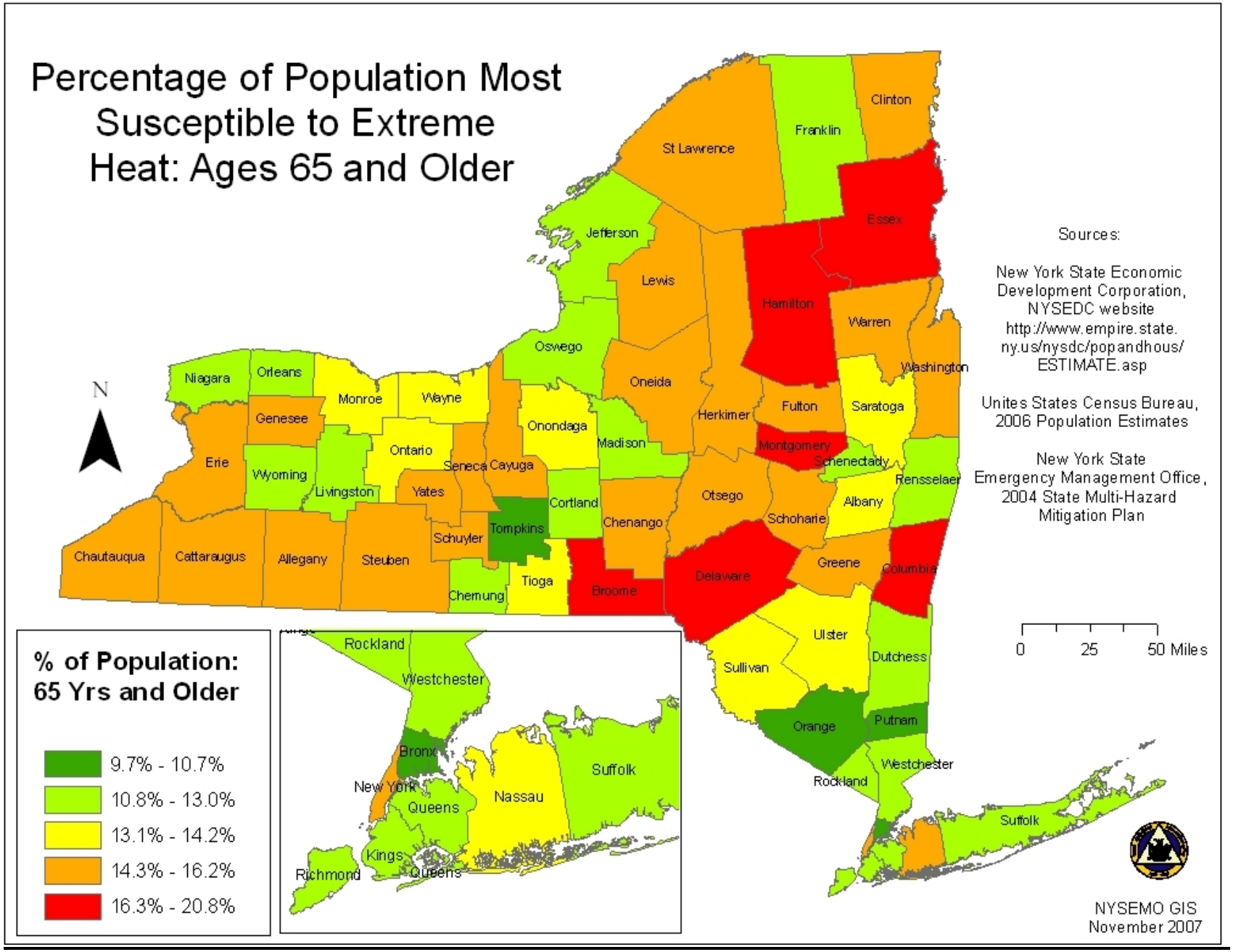

Percentage of Population Most Susceptible to Extreme Heat: Ages 65 and Older
Sources:
New York State Economic Development Corporation, NYSEDC website http://www.empire.state.ny.us/nysdc/popandhous/ESTIMATE.asp
Unites States Census Bureau, 2006 Population Estimates
New York State Emergency Management Office, 2004 State Multi-Hazard Mitigation Plan
N
0 25 50 Miles
% of Population: 65 Yrs and Older
9.7% - 10.7%
10.8% - 13.0%
13.1% - 14.2%
14.3% - 16.2%
16.3% - 20.8%
Clinton
Franklin
St Lawrence
Essex
Jefferson
Lewis
Hamilton
Warren
Washington
Oswego
Oneida
Herkimer
Fulton
Saratoga
Niagara
Orleans
Monroe
Wayne
Genesee
Onondaga
Madison
Montgomery
Schenectady
Rensselaer
Ontario
Erie
Wyoming
Seneca
Cayuga
Livingston
Yates
Cortland
Otsego
Albany
Schoharie
Tompkins
Chenango
Schuyler
Greene
Columbia
Chautauqua
Cattaraugus
Allegany
Steuben
Tioga
Delaware
Chemung
Broome
Ulster
Dutchess
Sullivan
Orange
Putnam
Westchester
Rockland
Suffolk
Rockland
Westchester
Bronx
New York
Queens
Nassau
Suffolk
Kings
Richmond
Queens
NYSEMO GIS
November 2007

Figure 3-125

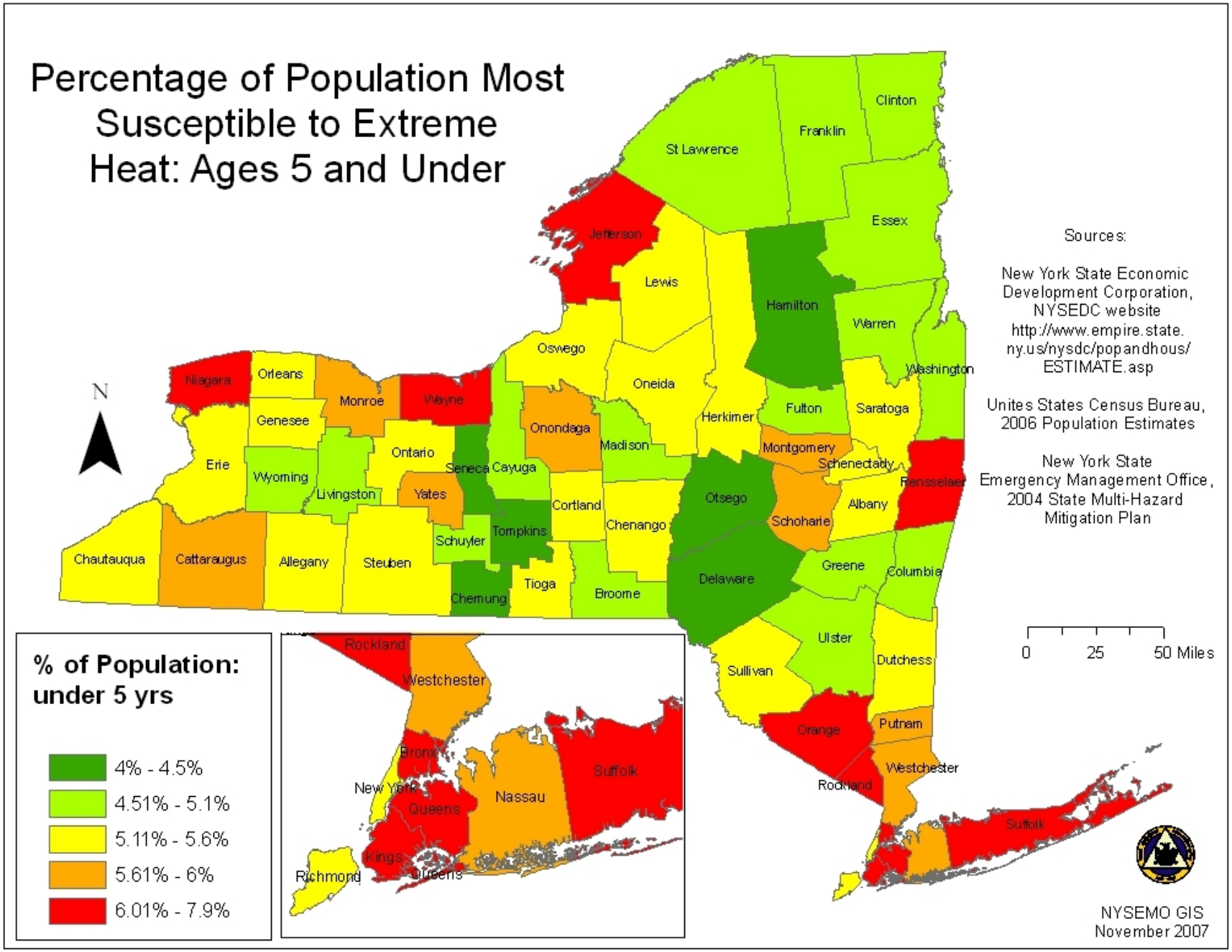
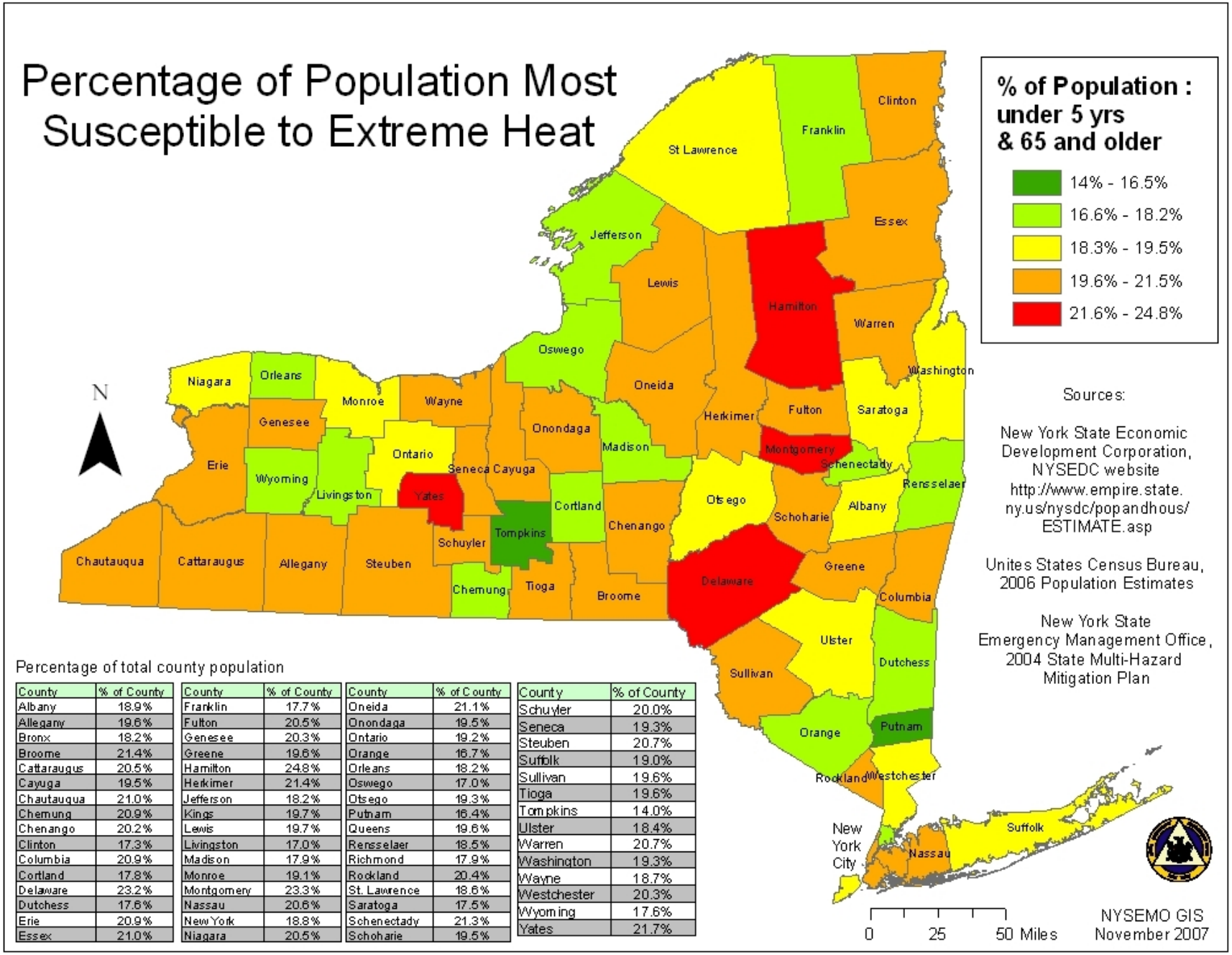

Percentage of Population Most Susceptible to Extreme Heat: Ages 5 and Under
N
Clinton
Franklin
St Lawrence
Essex
Jefferson
Lewis
Hamilton
Warren
Oswego
Washington
Niagara
Orleans
Monroe
Wayne
Oneida
Fulton
Saratoga
Genesee
Onondaga
Herkimer
Madison
Montgomery
Ontario
Schenectady
Erie
Seneca
Cayuga
Rensselaer
Wyoming
Livingston
Yates
Cortland
Otsego
Albany
Chenango
Schoharie
Tompkins
Schuyler
Chautauqua
Cattaraugus
Allegany
Steuben
Tioga
Greene
Columbia
Chemung
Broome
Delaware
Ulster
Dutchess
Sullivan
Orange
Putnam
Westchester
Rockland
Suffolk
Rockland
Westchester
Bronx
New York
Queens
Nassau
Suffolk
Kings
Richmond
Queens
% of Population: under 5 yrs
4% - 4.5%
4.51% - 5.1%
5.11% - 5.6%
5.61% - 6%
6.01% - 7.9%
Sources:
New York State Economic Development Corporation, NYSEDC website http://www.empire.state.ny.us/nysdc/popandhous/ESTIMATE.asp
Unites States Census Bureau, 2006 Population Estimates
New York State Emergency Management Office, 2004 State Multi-Hazard Mitigation Plan
0
25
50 Miles
NYSEMO GIS
November 2007

Figure 3-126



Percentage of total county population

County	% of County	County	% of County	County	% of County	County	% of County
Albany	18.9%	Franklin	17.7%	Oneida	21.1%	Schuyler	20.0%
Allegany	19.6%	Fulton	20.5%	Onondaga	19.5%	Seneca	19.3%
Bronx	18.2%	Genesee	20.3%	Ontario	19.2%	Steuben	20.7%
Broome	21.4%	Greene	19.6%	Orange	16.7%	Suffolk	19.0%
Cattaraugus	20.5%	Hamilton	24.8%	Orleans	18.2%	Sullivan	19.6%
Cayuga	19.5%	Herkimer	21.4%	Oswego	17.0%	Tioga	19.6%
Chautauqua	21.0%	Jefferson	18.2%	Otsego	19.3%	Tompkins	14.0%
Chemung	20.9%	Kings	19.7%	Putnam	16.4%	Ulster	18.4%
Chenango	20.2%	Lewis	19.7%	Queens	19.6%	Warren	20.7%
Clinton	17.3%	Livingston	17.0%	Rensselaer	18.5%	Washington	19.3%
Columbia	20.9%	Madison	17.9%	Richmond	17.9%	Wayne	18.7%
Cortland	17.8%	Monroe	19.1%	Rockland	20.4%	Westchester	20.3%
Delaware	23.2%	Montgomery	23.3%	St. Lawrence	18.6%	Wyoming	17.6%
Dutchess	17.6%	Nassau	20.6%	Saratoga	17.5%	Yates	21.7%
Erie	20.9%	New York	18.8%	Schenectady	21.3%		
Essex	21.0%	Niagara	20.5%	Schoharie	19.5%		

Table 3-52
Past Occurrences of Extreme Heat in New York State

Date	County/Area Effected	Injuries	Fatalities	Description
Jun 15, 1994 – Jun 18, 1994	Ulster	50	0	Record Heat occurred across much of eastern New York during the middle of June. In Dolgeville, 50 students were treated for heat exhaustion when all fans and air conditioners in the Dolgeville Elementary School failed.
Jul 13, 1995	Kings	Unknown	7	A heat wave during the month of July was responsible for several deaths. Hundreds were treated for various problems related to heat and high humidity. Temperatures rose to a record high of 102 in Central Park and hovered at 90 degrees or higher during July.
Jul 4, 1999 – Jul 6, 1999	NYC, Westchester, Putnam, Suffolk, Orange, Nassau	0	33	An extremely hot and humid air mass covered the region from July 4th through July 6th. On Sunday July 4th, temperatures soared into the mid and upper 90s. The combination of high temperatures and moderate humidity caused most heat indices to range from 100 to 105 degrees. On Monday July 5th, many new maximum temperature records were set throughout NYC metropolitan region. With temperatures and Heat indices in the 100's, widespread blackouts were observed throughout the region. The Heat Wave was directly responsible for killing 33 people in the New York Metro Area: 14 in Brooklyn, 13 from Manhattan, 3 from Queens, 2 from Westchester County, and 1 form the Bronx.
Aug 1, 2001 – Aug 10, 2001	Broome, Cayuga, Chemung, Chenango, Cortland, Delaware, Madison, Oneida, Onondaga, Otsego, Schuyler, Seneca, Steuben, Sullivan, Tioga, Tompkins, Yates	0	0	August was a very warm month across central New York. The first 9 days of the month featured a significant heat wave with several days of locations reporting temperatures in the upper 90's to lower 100's. Numerous high temperature records were set during this time. The heat wave peaked on the 9th when many locations saw temperatures above 100 degrees and some locations equaled or exceeded all-time temperature records for the month of August.
Aug 8, 2001 – Aug 10, 2001	Nassau, NYC, Putnam, Rockland, Suffolk, Westchester	0	4	A Bermuda high pressure system "pumped" hot temperatures and high humidities across the region. The 6 day heat wave began on Sunday, August 5th, when temperatures first reached 90 degrees at Central Park. Record high temperatures at Central Park were broken on two consecutive days, August 8th and 9th. High temperatures at Central Park reached 103 degrees on the 9th and 99 degrees on the 7th and 8th. Heat indices peaked across the entire

Date	County/Area Effected	Injuries	Fatalities	Description
				region on Thursday, August 9th to between 105 and 110 degrees. Heat indices were also quite high on Friday, August 10th, reaching 105 to 110 degrees, as humidity levels increased, despite slightly lower temperatures. As temperatures rose, the demand for electricity increased. Power outages occurred within the region between Aug 7th and Aug 10th. Long Island Power Authority reported about 21,000 outages throughout Long Island. Excessive Heat conditions caused portions of the Sunrise Highway to "buckle" ,which caused road closures. A total of 4 deaths were attributed to the heat. Three individuals from Manhattan and one from Brooklyn, ranging in ages from 57 – 82.
Aug 8, 2001 – Aug 9, 2001	Albany, Columbia, Dutchess, Fulton, Greene, Herkimer, Montgomery, Rensselaer, Saratoga, Schenectady, Ulster	15	0	A strong Bermuda high developed early in August and brought the most extensive heat wave of the summer to eastern New York and adjacent New England. Record temperatures were recorded in parts of Upstate New York. High humidity levels in addition to the heat produced heat indices between 105 – 110 near Albany and, 110 -115 in the Poughkeepsie region. St. Clare's Hospital in Schenectady reported 9 cases of heat-related symptoms. The victims were all children campers at the Pattersonville Camp also in Schenectady County. Four more campers were treated at the campsite. While there no other heat related problems reported to the National Weather Service, the heat led to record state electricity consumption, three days in a row. Governor Pataki closed down the State government at 2:00 PM on August 9 to conserve power. Hot weather also caused the railroad bridge to malfunction between the cities of Albany and Rensselaer, resulting in delays for four of Amtrak's passenger trains on August 9
Jul 2, 2002 – Jul 4, 2002	Nassau, New York City, Orange, Putnam, Rockland, Suffolk, Westchester	0	0	Temperatures rose into the mid and upper 90's across the region, averaging 10 – 15 degrees above normal. A record high was reached at LaGuardia Airport, at 98°. High humidity coupled with high temperatures produced heat indices of 100 – 105 degrees throughout the region. Hospital emergency rooms report minor cases of heat exhaustion and other heat-related ailments. Small power failures throughout the 4th of July left as many as 20,000 homes without electricity. There were brownouts throughout the NYC Metropolitan Area.

Date	County/Area Effected	Injuries	Fatalities	Description
Aug 1, 2006 – Aug 3, 2006	Nassau, NYC, Orange, Putnam, Rockland, Suffolk, Westchester	0	42	Three consecutive days of excessive heat occurred mainly from noon to midnight. With temperatures hovering in the 90s to 100 degrees and surface dew points in the mid 70s, heat indices ranged from 105 – 115 degrees. The excessive heat conditions resulted in 42 deaths and scattered power outages throughout the NYC Metropolitan Area. Forty of the forty-two deaths occurred within NYC: 14 in Queens, 14 in Brooklyn, 9 in Manhattan, and 3 in the Bronx. The NYC Office of Emergency Management opened 383 cooling centers that served 25,000 people per day. They also opened 6000 pools and extended their routine hours of operation. Record temperatures were set throughout the region.

***Source: National Climatic Data Center: NCDC Storm Events Database**

Mitigation Activities

At this time, it is impossible to stop an Extreme Heat event. Therefore, mitigation activities should be tailored towards protecting lives and preventing injury from an Extreme Heat event. The following are some sample mitigation activities which can save lives in the event of an Extreme Heat hazard:

- Identify location of vulnerable populations
- Establish cooling centers
- Issues advisories and warnings
- Conduct pre-season public information campaigns

As previously mentioned, it is up to Local Jurisdictions to do due diligence in accurately profiling Extreme Heat as well as vulnerable population which are more susceptible to excessive heat conditions. Preventing an extreme heat event is not plausible; however, limiting the extent of the hazard on the population is feasible.