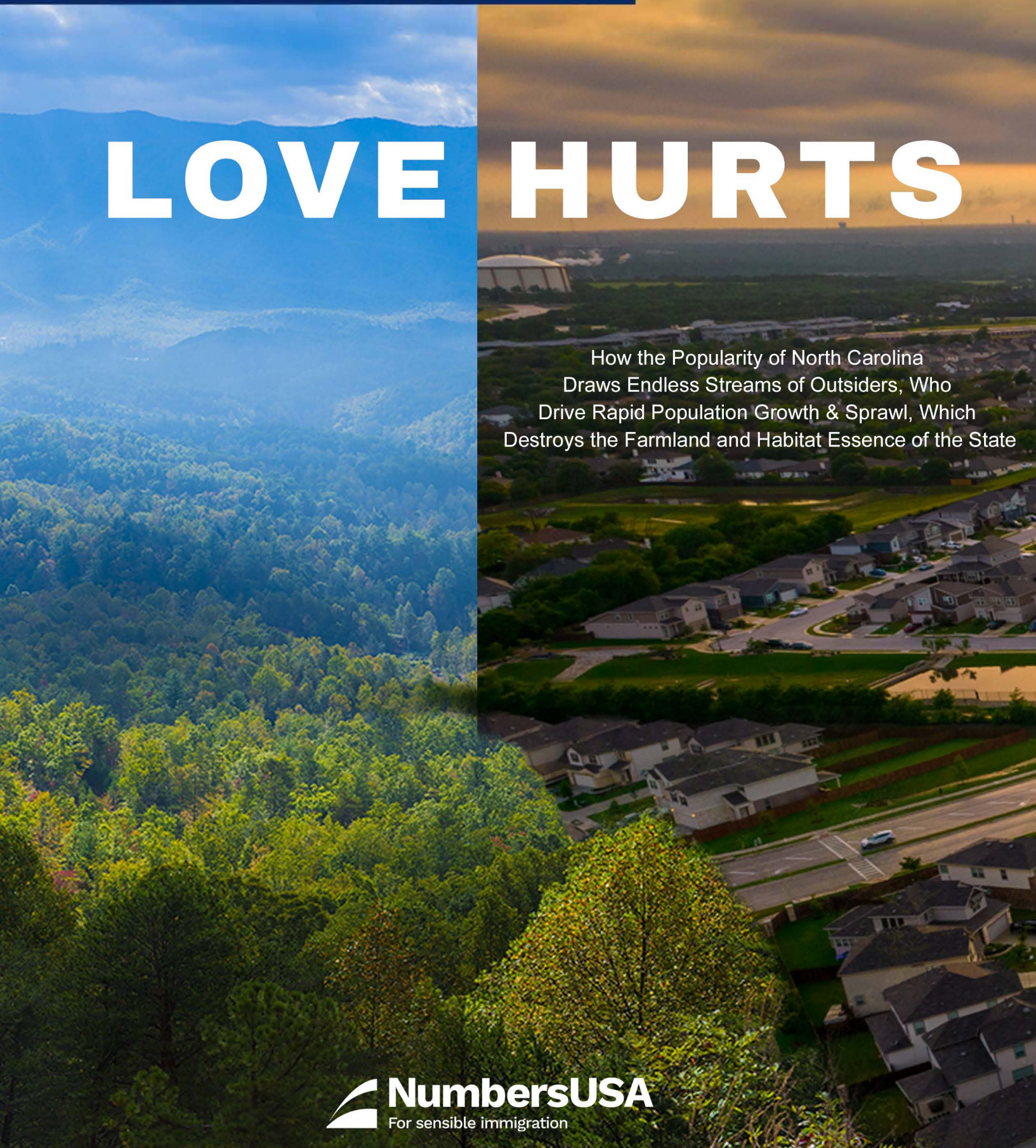
March 2024

NORTH CAROLINA SPRAWL

LOVE HURTS

How the Popularity of North Carolina
Draws Endless Streams of Outsiders, Who
Drive Rapid Population Growth & Sprawl, Which
Destroys the Farmland and Habitat Essence of the State



NumbersUSA
For sensible immigration

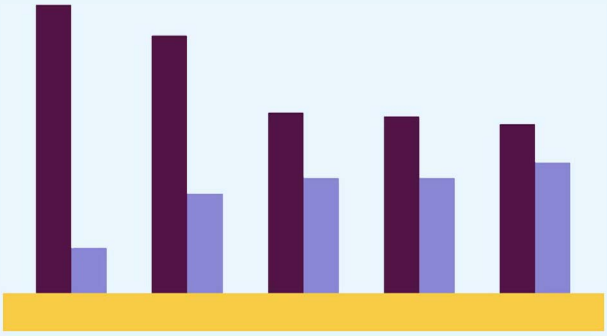
A Report by Leon Kolankiewicz and Roy Beck, with Eric A. Ruark

NORTH CAROLINA SPRAWL

LOVE HURTS

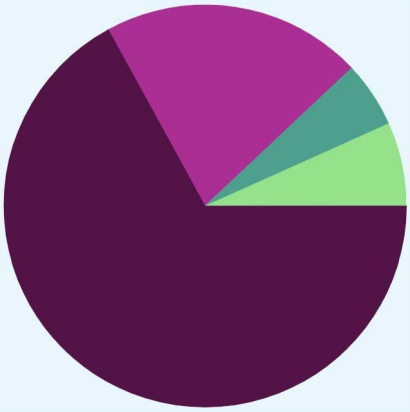
FINDINGS

www.NCSprawl.com



VOTER POLL RESULTS

www.NCSprawl.com/voter-poll



BACKGROUND, SOURCES, AND METHODOLOGY

NumbersUSA
For sensible immigration

NORTH CAROLINA SPRAWL

(A) POPULATION AND SPRAWL IN EACH NORTH CAROLINA COUNTY (1982-2017)

North Carolina County	1982 Population	2017 Population	Pop Change 1982 to 2017	% Pop Change 1982 to 2017	Developed Land 1982 (1,000's of acres)	Developed Land 2017 (1,000's of acres)	Change in Developed Land (Sprawl in square miles)	% Change In Developed Land	% Sprawl Related to Population Growth
Alamance Co.	101,000	163,276	62,276	62	43.6	67.2	36.9	54	100
Alexander Co.	25,572	37,143	11,571	45	9.6	27.7	28.3	189	35
Alleghany Co.	9,754	10,988	1,234	13	6.0	13.2	11.3	120	15
Anson Co.	25,317	24,829	-488	-2	14.0	25.4	17.8	81	0
Ashe Co.	22,496	26,787	4,291	19	16.1	31.1	23.4	93	27
Avery Co.	14,572	17,517	2,945	20	11.2	22.0	16.9	96	27
Beaufort Co.	41,613	47,033	5,420	13	29.1	46.3	26.9	59	26
Bertie Co.	21,048	19,263	-1,785	-8	8.2	15.6	11.6	90	0
Bladen Co.	30,147	33,443	3,296	11	8.2	18.8	16.6	129	13
Brunswick Co.	38,703	130,859	92,156	238	34.0	86.8	82.5	155	100
Buncombe Co.	163,693	257,071	93,378	57	45.0	119.3	116.1	165	46

NORTH CAROLINA SPRAWL

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North Carolina County	1982 Population	2017 Population	Pop Change 1982 to 2017	% Pop Change 1982 to 2017	Developed Land 1982 (1,000's of acres)	Developed Land 2017 (1,000's of acres)	Change in Developed Land (Sprawl in square miles)	% Change In Developed Land	% Sprawl Related to Population Growth
Burke Co.	73,583	90,157	16,574	23	52.2	70.9	29.2	36	66
Cabarrus Co.	89,158	206,988	117,830	132	38.1	72.8	54.2	91	100
Caldwell Co.	68,057	81,933	13,876	20	29.2	60.9	49.5	109	25
Camden Co.	5,675	10,532	4,857	86	3.0	6.6	5.6	120	78
Carteret Co.	43,762	68,921	25,159	57	24.4	52.4	43.8	115	59
Caswell Co.	21,416	22,616	1,200	6	6.3	16.7	16.3	165	6
Catawba Co.	107,754	157,852	50,098	46	67.7	102.2	53.9	51	93
Chatham Co.	34,430	71,189	36,759	107	24.0	53.0	45.3	121	92
Cherokee Co.	19,302	27,954	8,652	45	10.0	29.7	30.8	197	34
Chowan Co.	12,585	14,029	1,444	11	7.8	14.8	10.9	90	17
Clay Co.	6,878	11,004	4,126	60	5.2	10.8	8.8	108	64
Cleveland Co.	83,144	97,134	13,990	17	25.9	55.3	45.9	114	21

NORTH CAROLINA SPRAWL

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North Carolina County	1982 Population	2017 Population	Pop Change 1982 to 2017	% Pop Change 1982 to 2017	Developed Land 1982 (1,000's of acres)	Developed Land 2017 (1,000's of acres)	Change in Developed Land (Sprawl in square miles)	% Change In Developed Land	% Sprawl Related to Population Growth
Columbus Co.	50,859	56,047	5,188	10	31.5	50.1	29.1	59	21
Craven Co.	73,774	102,492	28,718	39	30.1	47.5	27.2	58	72
Cumberland Co.	251,394	330,994	79,600	32	49.3	106.9	90.0	117	36
Currituck Co.	11,537	26,290	14,753	128	8.6	23.8	23.8	177	81
Dare Co.	14,593	36,199	21,606	148	17.8	27.7	15.5	56	100
Davidson Co.	116,026	165,180	49,154	42	53.0	86.8	52.8	64	72
Davie Co.	25,316	42,308	16,992	67	11.6	23.8	19.1	105	71
Duplin Co.	40,638	58,943	18,305	45	17.4	35.4	28.1	103	52
Durham Co.	156,300	312,153	155,853	100	44.3	75.5	48.8	70	100
Edgecombe Co.	56,740	52,756	-3,984	-7	22.5	31.8	14.5	41	0
Forsyth Co.	249,154	375,840	126,686	51	59.4	108.2	76.3	82	69
Franklin Co.	30,769	66,155	35,386	115	11.2	45.5	53.6	306	55

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Gaston Co.	166,369	219,656	53,287	32	49.2	93.4	69.1	90	43
Gates Co.	8,936	11,514	2,578	29	4.3	9.5	8.1	121	32
Graham Co.	7,189	8,524	1,335	19	2.1	6.5	6.9	210	15
Granville Co.	34,790	59,372	24,582	71	9.0	30.4	33.4	238	44
Greene Co.	15,855	20,963	5,108	32	6.8	13.1	9.8	93	43
Guilford Co.	322,602	528,243	205,641	64	96.3	166.8	110.2	73	90
Halifax Co.	55,141	51,311	-3,830	-7	24.6	37.6	20.3	53	0
Harnett Co.	61,176	132,395	71,219	116	23.7	60.5	57.5	155	82
Haywood Co.	46,894	61,005	14,111	30	25.8	54.8	45.3	112	35
Henderson Co.	61,579	115,216	53,637	87	28.9	73.5	69.7	154	67
Hertford Co.	23,270	23,923	653	3	10.6	15.2	7.2	43	8
Hoke Co.	21,077	54,138	33,061	157	11.1	27.7	25.9	150	100

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Hyde Co.	5,879	5,240	-639	-11	6.4	10.3	6.1	61	0
Iredell Co.	84,487	175,634	91,147	108	43.8	102.4	91.6	134	86
Jackson Co.	26,400	43,224	16,824	64	6.7	48.7	65.6	627	25
Johnston Co.	72,058	196,374	124,316	173	31.4	94.6	98.8	201	91
Jones Co.	9,712	9,573	-139	-1	8.2	11.2	4.7	37	0
Lee Co.	37,405	60,403	22,998	61	20.1	42.6	35.2	112	64
Lenoir Co.	59,428	56,622	-2,806	-5	20.6	31.7	17.3	54	0
Lincoln Co.	43,361	82,557	39,196	90	11.6	43.8	50.3	278	48
McDowell Co.	35,838	45,083	9,245	26	15.0	33.9	29.5	126	28
Macon Co.	21,677	34,581	12,904	60	20.5	44.0	36.7	115	61
Madison Co.	16,919	21,563	4,644	27	7.3	16.1	13.8	121	31
Martin Co.	26,089	22,763	-3,326	-13	12.7	19.6	10.8	54	0

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Mecklenburg Co.	422,435	1,078,128	655,693	155	146.9	282.1	211.3	92	100
Mitchell Co.	14,316	14,992	676	5	3.5	13.7	15.9	291	3
Montgomery Co.	22,495	27,269	4,774	21	11.7	20.7	14.1	77	34
Moore Co.	51,394	97,368	45,974	89	29.2	75.8	72.8	160	67
Nash Co.	68,784	94,019	25,235	37	26.4	57.9	49.2	119	40
New Hanover Co.	107,489	228,728	121,239	113	34.3	70.2	56.1	105	100
Northampton Co.	21,941	19,890	-2,051	-9	9.1	16.6	11.7	82	0
Onslow Co.	118,881	195,066	76,185	64	32.5	81.1	75.9	150	54
Orange Co.	78,644	143,626	64,982	83	27.7	56.6	45.2	104	84
Pamlico Co.	10,636	12,638	2,002	19	6.8	13.4	10.3	97	25
Pasquotank Co.	28,781	39,386	10,605	37	9.6	20.4	16.9	113	42
Pender Co.	22,903	60,719	37,816	165	11.7	27.2	24.2	132	100

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Perquimans Co.	9,420	13,439	4,019	43	2.9	11.2	13.0	286	26
Person Co.	29,356	39,338	9,982	34	7.5	24.3	26.3	224	25
Pitt Co.	93,400	178,607	85,207	91	30.7	72.4	65.2	136	76
Polk Co.	13,799	20,564	6,765	49	10.5	25.8	23.9	146	44
Randolph Co.	93,626	143,037	49,411	53	37.1	80.9	68.4	118	54
Richmond Co.	44,468	44,827	359	1	26.6	38.4	18.4	44	2
Robeson Co.	103,114	132,626	29,512	29	38.6	73.2	54.1	90	39
Rockingham Co.	84,428	90,791	6,363	8	25.4	57.4	50.0	126	9
Rowan Co.	101,319	140,356	39,037	39	43.9	86.0	65.8	96	48
Rutherford Co.	55,280	66,529	11,249	20	14.8	51.6	57.5	249	15
Sampson Co.	49,170	63,263	14,093	29	22.0	42.4	31.9	93	38
Scotland Co.	32,839	35,174	2,335	7	15.7	24.1	13.1	54	16

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Stanly Co.	48,757	61,505	12,748	26	20.5	36.6	25.2	79	40
Stokes Co.	34,256	45,724	11,468	33	17.7	34.7	26.6	96	43
Surry Co.	59,896	72,107	12,211	20	22.5	42.7	31.6	90	29
Swain Co.	10,633	14,263	3,630	34	11.4	17.4	9.4	53	69
Transylvania Co.	24,095	33,767	9,672	40	14.8	36.8	34.4	149	37
Tyrrell Co.	4,059	4,180	121	3	3.6	4.4	1.3	22	15
Union Co.	73,308	231,350	158,042	216	28.1	74.4	72.3	165	100
Vance Co.	37,206	44,281	7,075	19	9.5	27.3	27.8	187	16
Wake Co.	316,973	1,071,706	754,733	238	112.1	294.3	284.7	163	100
Warren Co.	16,293	19,849	3,556	22	9.7	19.8	15.8	104	28
Washington Co.	14,476	11,944	-2,532	-17	5.3	10.6	8.3	100	0
Watauga Co.	33,549	55,181	21,632	64	18.1	41.0	35.8	127	61

(A) POPULATION AND SPRAWL IN EACH NORTH CAROLINA COUNTY (1982-2017)

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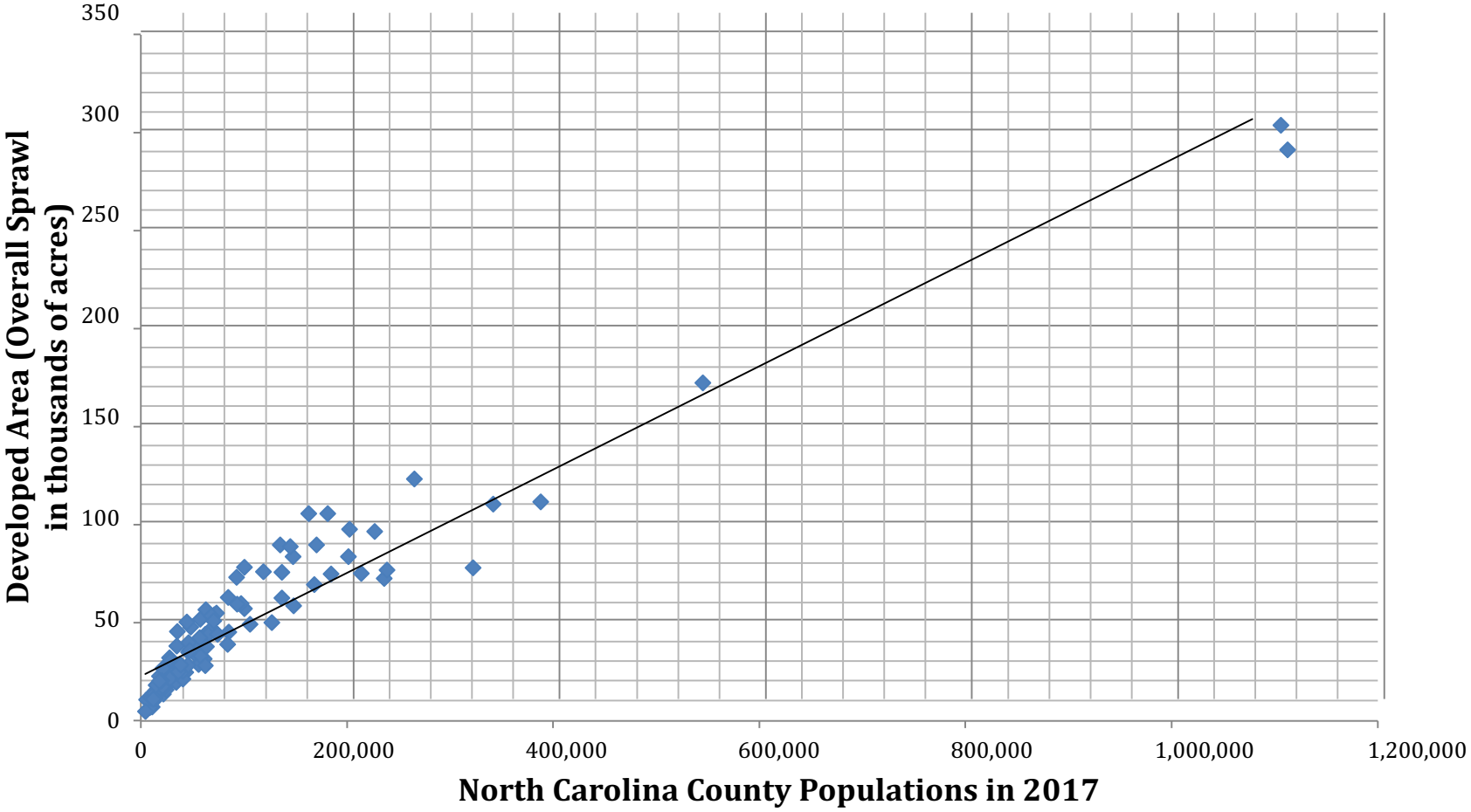
Wayne Co.	98,603	123,034	24,431	25	22.4	48.3	40.5	116	29
Wilkes Co.	59,191	68,489	9,298	16	23.0	49.1	40.8	113	19
Wilson Co.	63,816	81,436	17,620	28	21.7	37.7	25.0	74	44
Yadkin Co.	29,072	37,588	8,516	29	12.5	27.4	23.3	119	33
Yancey Co.	15,117	17,697	2,580	17	8.5	19.5	17.2	129	19
Totals	**6,019,108**	**10,268,233**	**4,249,125**	**71**	**2,358.7**	**4,915.8**	**3,995.5**	**108**	**73**
Weighted Average									**60**

NORTH CAROLINA SPRAWL

(A) POPULATION AND SPRAWL IN EACH NORTH CAROLINA COUNTY (1982-2017)



Scatter Plot for North Carolina County Populations versus Developed Land Area (Cumulative Sprawl) in 2017

R-value: 0.95

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

Sprawl in 49 States, 1982-2017, Ranked by Increase in Land Area

Sprawl Ranking 1982-2017	State	Overall Sprawl (in square miles), 1982-2017
1	Texas	6,633.8
2	Florida	4,353.0
3	North Carolina	3,995.5
4	Georgia	3,910.2
5	California	3,420.5
6	Pennsylvania	2,686.4
7	Tennessee	2,353.9
8	Michigan	2,208.1
9	Virginia	2,179.8
10	Ohio	2,148.8
11	South Carolina	2,125.9
12	Alabama	2,023.1
13	Arizona	1,744.1
14	New York	1,608.8
15	Kentucky	1,582.8

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

Sprawl Ranking 1982-2017	State	Overall Sprawl (in square miles), 1982-2017
16	Washington	1,436.1
17	Illinois	1,332.2
18	Missouri	1,328.8
19	Wisconsin	1,261.1
20	Mississippi	1,217.0
21	Indiana	1,203.4
22	Louisiana	1,191.6
23	Minnesota	1,145.9
24	Oklahoma	1,133.4
25	Colorado	1,206.0
26	New Jersey	1,076.7
27	Massachusetts	1,038.1
28	Arkansas	1,034.8
29	New Mexico	1,018.6
30	Maryland	877.0
31	West Virginia	827.3
32	Utah	712.7
33	Oregon	687.5
34	Kansas	626.9

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

Sprawl Ranking 1982-2017	State	Overall Sprawl (in square miles), 1982-2017
35	Idaho	582.7
36	Maine	581.1
37	Iowa	505.5
38	Nevada	498.8
39	New Hampshire	498.6
40	Montana	415.6
41	Connecticut	319.7
42	Nebraska	270.2
43	South Dakota	251.7
44	Wyoming	251.3
45	North Dakota	232.8
46	Vermont	224.1
47	Delaware	216.7
48	Hawaii	136.3
49	Rhode Island	99.1
	Total	**68,334.1**

Source: 2017 NRCS National Resources Inventory; Table 1
Note: Includes all states except Alaska; does not include territories

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

Table 8. Population Change in 49 States, 1982-2017, Ranked By Numerical Growth

State	1982 Population	2017 Population	Population Growth, 1982-2017
California	24,820,007	39,358,497	14,538,490
Texas	15,331,408	28,295,273	12,963,865
Florida	10,471,405	20,963,613	10,492,208
Georgia	5,649,788	10,410,330	4,760,542
North Carolina	6,019,108	10,268,233	4,249,125
Arizona	2,889,860	7,044,008	4,154,148
Washington	4,276,551	7,423,362	3,146,811
Virginia	5,492,785	8,463,587	2,970,802
Colorado	3,061,562	5,611,885	2,550,323
Nevada	881,538	2,969,905	2,088,367
Tennessee	4,646,043	6,708,799	2,062,756
New York	17,589,737	19,589,572	1,999,835
South Carolina	3,207,611	5,021,268	1,813,657
Maryland	4,282,923	6,023,868	1,740,945
Utah	1,558,314	3,101,042	1,542,728
Oregon	2,664,919	4,143,625	1,478,706
New Jersey	7,430,970	8,885,525	1,454,555
Minnesota	4,131,450	5,566,230	1,434,780
Illinois	11,423,413	12,778,828	1,355,415
Indiana	5,467,918	6,658,078	1,190,160
Missouri	4,929,456	6,106,670	1,177,214
Massachusetts	5,771,222	6,859,789	1,088,567
Wisconsin	4,728,862	5,790,186	1,061,324
Alabama	3,925,263	4,874,486	949,223
Pennsylvania	11,845,146	12,787,641	942,495
Ohio	10,757,085	11,659,650	902,565
Michigan	9,115,196	9,973,114	857,918
Kentucky	3,683,449	4,452,268	768,819

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

State	1982 Population	2017 Population	Population Growth, 1982-2017
Idaho	973,719	1,717,715	743,996
New Mexico	1,363,822	2,091,784	727,962
Oklahoma	3,206,129	3,931,316	725,187
Arkansas	2,294,254	3,001,345	707,091
Kansas	2,401,207	2,908,718	507,511
Connecticut	3,139,014	3,573,297	434,283
Mississippi	2,556,776	2,988,510	431,734
Hawaii	993,780	1,424,393	430,613
New Hampshire	947,720	1,348,787	401,067
Delaware	599,148	956,823	357,675
Nebraska	1,581,776	1,915,947	334,171
Louisiana	4,352,609	4,670,560	317,951
Iowa	2,888,190	3,141,550	253,360
Montana	803,984	1,052,482	248,498
Maine	1,136,683	1,334,612	197,929
South Dakota	690,597	872,868	182,271
Vermont	519,108	624,344	105,236
Rhode Island	954,170	1,055,673	101,503
North Dakota	668,972	754,942	85,970
Wyoming	506,400	578,931	72,531
West Virginia	1,949,605	1,817,004	(132,601)
Entire USA*	**230,580,652**	**322,126,540**	**92,970,281**

Source: U.S. Census Bureau population estimates
***Note**: Includes all states except Alaska; does not include territories

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

State	2002 Population	2017 Population	Population Growth, 2002-2017
Texas	21,690,325	28,295,273	6,604,948
California	34,871,843	39,358,497	4,486,654
Florida	16,689,370	20,963,613	4,274,243
North Carolina	8,326,201	10,268,233	1,942,032
Georgia	8,508,256	10,410,330	1,902,074
Arizona	5,396,255	7,044,008	1,647,753
Washington	6,052,349	7,423,362	1,371,013
Virginia	7,286,873	8,463,587	1,176,714
Colorado	4,490,406	5,611,885	1,121,479
South Carolina	4,107,795	5,021,268	913,473
Tennessee	5,795,918	6,708,799	912,881
Nevada	2,173,791	2,969,905	796,114
Utah	2,324,815	3,101,042	776,227
Oregon	3,513,424	4,143,625	630,201
Maryland	5,440,389	6,023,868	583,479
Minnesota	5,018,935	5,566,230	547,295
Indiana	6,155,967	6,658,078	502,111
Pennsylvania	12,331,031	12,787,641	456,610
New York	19,137,800	19,589,572	451,772
Massachusetts	6,417,206	6,859,789	442,583
Oklahoma	3,489,080	3,931,316	442,236
Missouri	5,674,825	6,106,670	431,845
Alabama	4,480,089	4,874,486	394,397
Idaho	1,340,372	1,717,715	377,343
Kentucky	4,089,875	4,452,268	362,393
Wisconsin	5,445,162	5,790,186	345,024
New Jersey	8,552,643	8,885,525	332,882

(B) HOW NORTH CAROLINA COMPARES WITH OTHER STATES

State	2002 Population	2017 Population	Population Growth, 2002-2017
Arkansas	2,705,927	3,001,345	295,418
Illinois	12,525,556	12,778,828	253,272
Ohio	11,407,889	11,659,650	251,761
New Mexico	1,855,309	2,091,784	236,475
Iowa	2,934,234	3,141,550	207,316
Kansas	2,713,535	2,908,718	195,183
Nebraska	1,728,292	1,915,947	187,655
Hawaii	1,239,613	1,424,393	184,780
Louisiana	4,497,267	4,670,560	173,293
Delaware	806,169	956,823	150,654
Montana	911,667	1,052,482	140,815
Mississippi	2,858,681	2,988,510	129,829
North Dakota	638,168	754,942	116,774
Connecticut	3,458,749	3,573,297	114,548
South Dakota	760,020	872,868	112,848
New Hampshire	1,269,089	1,348,787	79,698
Wyoming	500,017	578,931	78,914
Maine	1,295,960	1,334,612	38,652
West Virginia	1,805,414	1,817,004	11,590
Vermont	615,442	624,344	8,902
Rhode Island	1,065,995	1,055,673	(10,322)
Michigan	10,015,710	9,973,114	(42,596)
Entire USA*	**286,409,698**	**323,550,933**	**37,141,235**

Source: U.S. Census Bureau population estimates

***Note**: Includes all states except Alaska; does not include territories

(C) THE THREAT TO NORTH CAROLINA WILDLIFE

North Carolina supports quite high levels of biodiversity. But many unique ecological communities native to the region have already been modified, compromised and reduced by human actions.[1]

These actions include habitat loss, alteration, and fragmentation due to urbanization, conversion to agriculture, clearcut logging, fire suppression, and filling or draining of wetlands.

Regional scientists cite the case of the once widespread but now severely diminished longleaf pine (Pinus palustris) ecosystem which once dominated as much as 90 million acres from southern Virginia to Florida and west to eastern Texas, but now occupies less than five percent of its former range.

The longleaf pine ecosystem contains possibly the most species-rich communities outside of the tropics, including many highly endangered species such as the Red-cockaded Woodpecker (Leuconotopicus borealis).

If recent population growth and development patterns continue, a gigantic megalopolis may form by 2060, sprawling over farmland and habitat from Raleigh-Durham through Charlotte and on to Atlanta, according to a joint study by the U.S. Geological Survey and North Carolina State University.[2]

The team's simulations indicated that by 2060 the extent of urbanization in the Southeast would increase by 101% to 192%, or two to nearly three times more than the area of land already developed. These projected land use changes and the emergence of a new megalopolis over the coming decades would impose enormous adverse effects on the Southern Piedmont region's existing largely rural character, natural habitats, biodiversity, farmlands, and quality of life. They would also compromise the region's environmental sustainability.

The threat to wildlife would be even greater than the 101% to 192% lost land because of the fragmentation of habitats. New roads and housing that are widely spread apart as they are added to rural areas well beyond the megalopolis may appear from the air to be only moderately destructive.

But even if the calculated square miles of sparse new development may appear modest, the increasingly fragmented natural landscape would compromise available habitat, repress ecologically important natural disturbance processes (such as wildfires), stymie management actions such as prescribed fire in the wildland-urban interface, and likely truncate or eliminate existing wildlife corridors. Moreover, all these impacts could take place concurrently, posing a particularly difficult threat to already vulnerable species and ecosystems.

Not only would habitats and corridors for wildlife be lost, but the continuous urban corridor would have a warmer climate than surrounding rural areas.

Read more at "Paving The Piedmont" (2017).

[1] Reed F. Noss. 2012. Forgotten Grasslands of the South: Natural History and Conservation. Washington, DC: Island Press.

[2] Adam J. Terando, Jennifer Costanza, Curtis Belyea, Robert R. Dunn, Alexa McKerrow, Jaime A. Collazo. 2014. The Southern Megalopolis: Using the Past to Predict the Future of Urban Sprawl in the Southeast U.S. PLOS ONE, Vol. 9, Issue 7. July. Available online at: www.plosone.org

(D) IMPORTANCE OF NATURE TO REJUVENATE HUMAN RESIDENTS

Open space, parks, green spaces, natural areas – including wetlands, riparian corridors, farmland, beaches, rivers, lakes, the ocean, fields and forests – provide demonstrable mental and physical health benefits. They have proven to be preventative measures that can actually lower health care costs and reduce the need for health interventions. Exploring or even just gazing upon natural areas – such as a swamp or mangrove-fringed estuary next to a city – gives human beings a sense of perspective, continuity in a changing world, spiritual renewal, well-being, and a feeling of harmony with the world around us. The presence of open space within and adjacent to our urban areas – and the assurance that this open space will outlast us – serves to counter-balance the stress and strain of modern life.

Contact with nature and open space provides both physiological and psychological benefits. Research on the physiological benefits of open space has centered on how direct or indirect (vicarious) experience with vegetated and/or natural landscapes reduces stress, and anxiety.103 A series of studies spanning nearly 20 years in the seventies and eighties linked photo simulations of natural settings to reduced stress levels as measured by heart rate and brain waves. One study revealed that subjects experienced more "wakeful relaxation" in response to slides showing vegetation only and vegetation with water compared to urban scenes without vegetation. These data were corroborated by attitude measures which indicated lower levels of fear and sadness when experimental subjects observed nature-related slides, as opposed to urban slides.104 In studies of hospital patients, recovery was faster, there were fewer negative evaluations in patient reports, and there was less use of anesthetic medication among post-surgery patients with views of exterior greenery than among control group patients with views of buildings.[105]

In new research published in 2023 in the peer-reviewed journal Science Advances, epidemiologists found that long-term exposure to more greenery can increase life expectancy by up to 2.5 years. "Our study shows that being near green space caused some biological or molecular changes that can be detected in our blood," said the study's principal investigator Lifang Hou, a preventive medicine professor at Northwestern University's Feinberg School of Medicine. Apparently, exposure to nature, and living near or in greener spaces can actually modify how genes are expressed (epigenetics), in effect, "getting under our skin" in a positive way.[106]

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[103] Rubenstein, N.R. The Psychological Value of Open Space. Chapter 4 in *The Benefits of Open Space*. The Great Swamp Watershed Association. 1997. Available on the World Wide Web at: http://www.greatswamp.org.

[104] Ulrich, R. 1979. Visual landscapes and psychological well-being. *Landscape Research*, 4(1): 17-23. 105 Ulrich, R. 1983. Aesthetic and affective response to natural environment. Chapter 3 in I. Altman, & J. F. Wohlwill (Eds.), Human Behavior and Environment: Volume 6 (pp. 85-126). New York: Plenum Press; Ulrich, R. 1984. Views through a window may influence recovery from surgery. Science, 224, 420-421.

[106] Allyson Chiu. 2023. Living near green spaces could add 2.5 years to your life, new research finds. Washington Post. June 28. Available online at: https://www.washingtonpost.com/climate-solutions/2023/06/28/aging-green-spaces-nature-health/; Kyeezu Kim et al. 2023. Inequalities in urban greenness and epigenetic aging: Different associations by race and neighborhood soicioeconomic status. Science Advances. 28 June. Vol. 9, Issue 26. Available online at: https://www.science.org/doi/10.1126/sciadv.adf8140.

(D) IMPORTANCE OF NATURE TO REJUVENATE HUMAN RESIDENTS

In other research, breast cancer survivors who engaged in personally enjoyable and nature-related "restorative activities" showed dramatic effects on their cognitive process and quality of life.[107] At the end of three months, the experimental group showed significant improvements in attention and self-reported quality of life measures; they had begun a variety of new projects. Control group members, meanwhile, who had been given no advice regarding nature exposure activities, continued with deficits in measures of attention, had started no new projects, and had lower scores on quality of life measures. This research underscored that difference between nature as an amenity and as a human need. As one reviewer of the study observed:

> "People often say that they like nature; yet they often fail to recognize that they need it...Nature is not merely 'nice.' It is not just a matter of improving one's mood, rather it is a vital ingredient in healthy human functioning."[108]

There is an important distinction between nature as amenity and nature as need. As one book affirms:

> "Viewed as an amenity, nature may be readily replaced by some greater technological achievement. Viewed as an essential bond between human and other living things, the natural environment has no substitutes."[109]

[107] Cimprich, B. E. 1990. Attentional fatigue and restoration in individuals with cancer. Unpublished Doctoral Dissertation, University of Michigan.
[108] Kaplan, S. (1992). The Restorative Environment: Nature and human experience. In D. Relf (ed.), *The Role of horticulture in human well-being and social development: A National Symposium* [Proceedings of Conference Held 19-21 April 1990, Arlington, VA] (pp. 134-142). Portland, OR: Timber Press.
[109] Kaplan, R., & Kaplan, S. (1989). *The Experience of nature: A Psychological perspective*. New York: Cambridge University Press.

(D) IMPORTANCE OF NATURE TO REJUVENATE HUMAN RESIDENTS

While there are many anecdotal reports linking the natural environment or open space to everything from increased self-esteem to stress reduction, there are few studies attempting to categorize the many phrases used to identify the worth of a walk in the woods or a day bird-watching beside a marsh.[110] Few studies track long-term longitudinal effects on changed attitudes and behavior. While it is difficult to characterize and quantify the long-term, intangible manner in which lives are modified, it is easy to acquire narrative accounts about the effect of a favorite overlook, trail, or patch of woods on one's psyche. One of the best known of such testimonials is from pioneering naturalist-conservationist John Muir:

> "Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop away from you like the leaves of Autumn."[111]

Natural settings are unparalleled in their ability to furnish solitude, privacy, and tranquility. They also have "existence value," that is, there is value to knowing that they are simply there and to the very idea that we *could* get away into them, if we so chose; this is a value in and of itself, which provides for a psychological "time-out" and a sense of wellbeing.

[110] Op. cit. Footnote #48. Rubenstein.
[111] John Muir. *The Mountains of California*. First published in 1894.

(E) SOURCES OF NORTH CAROLINA POPULATION GROWTH

FAMILY SIZE: The population growth causing the lost habitat and farmland has little to do with decisions of North Carolinians about family size. Their Total Fertility Rate (TFR) of births per woman has been below the "replacement level" of 2.1 since 2010, and below 1.8 TFR since 2016.

(See: https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_fertility_rate)

FEDERAL IMMIGRATION POLICIES loom as the biggest single factor in the nation's current population growth, accounting for nearly 90%. Demographic projections made in 2015 by the Pew Research Center indicated that future immigration would comprise some 88% of the projected U.S. population growth to 2060.

(See: Modern Immigration Wave Brings 59 Million to U.S., Driving Population Growth and Change Through 2065," September 28, 2015, Pew Research Center, https://www.pewresearch.org/hispanic/2015/09/28/modern-immigration-wave-brings-59-millionto-u-s-driving-population-growth-and-change-through-2065/)

CALCULATING DIRECT IMMIGRATION EFFECT IN NORTH CAROLINA: Federal data show that about 25% of the state's population growth from 1982 to 2017 was a result of post-1982 foreign immigration.

Almost 1.1 million North Carolina residents in 2017 were foreign-born residents who had arrived in the U.S. after 1982, or were post-1982 immigrants' U.S.-born children and grandchildren in the state, none of whom would be in the state — or country — except for federal immigration policies.

Our estimate of immigration's impact on North Carolina's population growth between 1982 and 2017 is based on an analysis of the public use files of the 2017 American Community Survey (ACS) and the 1999 and 2017 Current Population Survey Annual Social and Economic Supplements (CPS ASEC). It is well established that these Census Bureau surveys capture both legal and illegal immigrants, though some modest fraction is missed. The ACS and CPS identify immigrants (also called the foreign born) and ask what year they came to the United States. We use the ACS to measure the number of immigrants living in North Carolina who entered in 1982 or later. In addition to identifying immigrants and their year of arrival, the CPS also asks each respondent the birthplace of their parents, allowing us to measure the progeny of post-1982 immigrants in the state.

The 2017 ACS shows 719,200 immigrants living in North Carolina who indicated they arrived in the country in 1982 or later. This number has been adjusted to exclude half of those who indicated that they arrived in the year 1982. This is necessary because the ACS and the population estimates on which overall state population growth is based reflect the population on July 1 of each year. However, the ACS measures immigrant arrivals by calendar year. In addition to immigrants who arrived 1982 or later, we also find based on the 2017 CPS ASEC that there were 255,988 U.S.-born children (under age 18) of post-1982 immigrants in the state. (We exclude those with only an immigrant father to avoid double counting.) As these children still live with their parents, estimating their number is straightforward.

(E) SOURCES OF NORTH CAROLINA POPULATION GROWTH

To estimate the number of U.S.-born adults in 2017 with post-1982 immigrant parents, we use the 1999 CPS ASEC. In 1999, these individuals were still minors and lived with their immigrant parents, making possible to estimate the year their parents arrived in the United States. In 1999, 50.7 percent of second-generation children born 1982 to 1999 with a foreign-born mother were the child of a parent who came in 1982 or later.

The remainder of U.S.-born second-generation Americans in this age group were born to immigrant parents who arrived prior to 1982. Applying this percentage to those in the survey who are ages 18 to 35 and report they are the children of an immigrant in 2017 means there were 65,094 U.S.-born adult children of post-1982 immigrants in North Carolina. It must be remembered that immigration increased over the entire 1982 to 2017 period, so there are many more recent arrivals in North Carolina than immigrants who arrived in the earlier part of this time period. This means the vast majority of the offspring of immigrants are under age 18 in 2017 and this is why there are so many more minor children of post-1982 immigrants relative to adult offspring.

Finally, we find that there were 56,708 minor children with second generation parents who are 18 to 35 in 2017. These second generation parents are old enough to have a child, but young enough to have been born to a post-1982 immigrant. We again assume that 50.7 percent of these second-generation parents are the offspring of post-1982 immigrants giving us an estimated 28,749 U.S.-born grandchildren.

In total, we estimate there were 1.069 million post-1982 immigrants, their children and grandchildren living in North Carolina in 2017. The state's total population was 6.019 million in 1982 and 10.276 million in 2017. Immigration therefore accounted for 25.1 percent of the 4.257 million increase in the state's population over this time period.

TOP SENDING STATES: Most recently, 2022 data of people relocating into and out of North Carolina showed the highest net additions coming from New York, Virginia, Florida, and California. The counties of Northern Virginia have among the highest concentrations of foreign-born in the nation. The other three states are No. 3, No. 4 and No. 1 in percentage of foreign-born among their residents. (North Carolina ranks 24th.)

(See: https://www.usnews.com/news/best-states/slideshows/states-with-the-highest-shares-of-foreign-born-residents?slide=12)

MOVING VANS: These states saw the largest influx of movers in 2023, according to U-Haul in its annual survey:

1. Texas
2. Florida
3. North Carolina
4. South Carolina
5. Tennessee

(See: https://thehill.com/changing-america/enrichment/arts-culture/4385097-the-states-movers-flocked-to-the-most-in-2023-according-to-u-haul/)

(F) SPRAWL DATA SOURCES

Over the past few decades, dozens of diverse factors have been suggested as causes of America's relentless, unending sprawl, defined here as the expansion of urban land at the expense of rural land.

1. One factor is population growth.
2. All the other factors combine to increase per capita land consumption.

This study examines the relative importance of those two overall factors.

The word "sprawl" is not a precise term. But we do indeed use the term "Overall Sprawl" in a precise way in this study – it is the amount of rural land lost to development.

Fortunately, it is easy to measure the amount of Overall Sprawl because of two distinct, painstaking processes conducted by two unrelated federal agencies: the U.S. Census Bureau (Census) and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA). Using data from decennial censuses, Census has tabulated changes in the size and shape of the nation's Urbanized Areas (UAs) every 10 years for more than a half a century (since 1950), while the NRCS has estimated changes in the size and shape of America's Developed Lands in National Resources Inventories (NRIs) developed every five years or so for almost 40 years (since 1982). This study, unlike others we have prepared over the past 20 years, uses only the NRI data (in conjunction with Census population estimates for each county in the 49 states covered).

The NRCS uses remote sensing, survey, and statistical techniques to derive NRI's estimates of changes in land use on the nation's non-federal lands. Built-up or developed lands are one of the categories of land use NRCS delineates.

County-by-county Developed Land data from the 1982-2017 National Resources Inventories served as the main data source for our current study of sprawl in the United States. While the Census data pertain to a discrete list of designated cities, the NRI data furnish a portrait that also includes development in places in counties around the country that are outside of the boundaries of the Census Bureau's UAs. Therefore, we were able to assess and include traditional sprawl and development within American cities as well as the more diffuse development and sprawl dispersed across the entire state, as evidenced in the NRI data. The NRI refers to these areas of more dispersed development as "Small Built-up Areas." In 2015, Small Built-up Areas comprised 7.4 million acres or about six percent of the total of 116.3 million acres of Developed Land in the contiguous United States.

(F) SPRAWL DATA SOURCES

This study quantifies the amount of sprawl in the United States (except for Alaska) over the most recent periods for which the most comprehensive government data are available: 1982-2017. Available NRI Developed Land estimates span an uninterrupted 35-year period from 1982-2012 in seven 5-year intervals (1982-1987, 1987-1992, 1992-1997, 1997-2002, 2002-2007, 2007-2012, 2012-2017). These estimates quantify how much rural land was converted into developed or built-up land over these discrete time intervals, as well as over the 35-year time period in its entirety.

The NRI is based on rigorous scientific and survey protocols. The U.S. Department of Agriculture's NRCS began developing the NRI in 1977 in response to several Congressional mandates. The first NRI published in 1982 used most of the survey methodology and protocols utilized by earlier inventories. However, the scope and sample size of the 1982 NRI were expanded to meet the demands of the Soil and Water Resources Conservation Act (RCA) of 1977, as well as to better address emerging issues like the permanent loss of agricultural lands to nonagricultural uses, such as transportation, industry, commercial and residential land uses.[89]

The NRI covers the entire surface area (both land and water) of the United States, including all 50 states, Puerto Rico, the U.S. Virgin Islands, and certain Pacific Basin islands. The sample includes all land ownership categories, including federal lands (e.g., national parks, national wildlife refuges, national forests, Bureau of Land Management lands, military installations), although NRI data collection activities have historically focused on non-federal lands. Sampling is conducted on a county-by-county basis, using a stratified, two-stage, area sampling scheme. The two-stage sampling units are nominally square segments of land and points within these segments. The segments are typically half-mile-square parcels of land equal to 160-acre quarter-sections (a section is a square of territory one mile on each side, and comprising one square mile or 640 acres in area) in the Public Land Survey System, but there are a number of exceptions in the western and northeastern U.S. Three specific sample points are selected for most segments, although two are selected for 40-acre segments in irrigated portions of some western States, and some segments originally contained only one sample point.[90]

The 1997 NRI sample contained about 300,000 sample segments and 800,000 sample points. Whereas the NRI was conducted every five years up to 1997, an annual or continuous approach was begun in 2000. Each year a subset of between 71,000 and 72,000 segments from the 1997 sample is selected for observation. The subset is selected using a "supplemented panel rotation" design, meaning that a "core panel" of about 40,000 segments is observed each year along with a different supplemental or rotation panel chosen for each year.

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[89] U.S. Department of Agriculture. 2009. *Summary Report: 2007 National Resources Inventory*, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 pages. http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf.

[90] Ibid.

The NRI survey system uses points as the sampling units rather than farms or fields, because land use and land unit boundaries often change in some parts of the country. Utilizing points has allowed the survey process to generate a database with dozens of factors or data elements that are properly correlated over many years. Thus, analyses and inferences based on these data are using proper combinations of longitudinal data.[91]

Data for the initial 1982 NRI were collected by thousands of field staff of the Soil Conservation Service (SCS – precursor agency to NRCS), whose efforts were supplemented by contractors

and employees of other agencies working under SCS supervision. Data collection began in the spring of 1980 and ran for more than two years, finishing in the autumn of 1982. For the 1987 NRI, data were also collected by teams of trained personnel. Remote sensing techniques (via aircraft or satellite) were used to update 1982 conditions for about 30 percent of the sample sites. Reliance upon remote sensing increased during the 1990s. Beginning in 2000, special high-resolution imagery was obtained for each NRI sample site.[92]

In 2004, NRCS established Remote Sensing Laboratories (RSLs) in Greensboro, NC; Fort Worth, TX; and Portland, OR. These three labs were designed, equipped, and staffed to take advantage of modern geospatial technologies, enabling efficient collection and processing of NRI survey data. The RSLs are now staffed with permanent employees whose full-time job is NRI data collection and processing.[93]

A number of quality control and quality assurance (QC/QA) processes are conducted by NRCS and contract staff as well as by the Statistical Unit and NRCS resource inventory specialists. Many of these QC/QA processes are embedded within the survey software developed by NRCS and the Statistical Unit. The QC/QA processes ensure that differences in the data over time reflect actual changes in resource conditions, rather than differences in the perspectives of two different data collectors, or changes in technologies and protocols.

One of the special features of the NRI is its genuine longitudinal nature, that is, its reliability and consistency through time, so that users of this dataset can be confident that, for example, differences in the area of developed land shown for 2007 and 1997 accurately reflect true differences "on the ground" or in reality. Even though many operational features of the NRI survey program have evolved over the years, processes have been implemented to ensure that data contained within the 2007 NRI database are longitudinally consistent. Data collection protocols always include review and editing of historical data for the particular NRI sampling units being observed.[94]

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[91] Ibid.

[92] Ibid.

[93] Ibid.

[94] Ibid.

(F) SPRAWL DATA SOURCES

NRI's broadest classification divides all U.S. territory into three categories: federal land, water areas, and non-federal land. Non-federal land is divided into developed and rural. Rural lands are further subdivided into cropland, Conservation Reserve Program (CRP) land, pastureland, rangeland, forestland, and other rural land. In the present study we are concerned only with developed land.

NRI's category of Developed Land differs from that used by other federal data collection entities. While other studies and inventories emphasize characteristics of human populations (e.g., Census of Population) and housing units (e.g., American Housing Survey), for the NRI, the intent is to identify which lands have been permanently eliminated from the rural land base. The NRI Developed Land category includes: (a) large tracts of urban and built-up land; (b) small tracts of built-up land less than 10 acres in size; and (c) land outside of these built-up areas that is in a rural transportation corridor (roads, interstates, railroads, and associated rights-of-way).

(G) PER CAPITA LAND CONSUMPTION

Per capita land consumption statistics are a useful way to understand the combined power of numerous land use and consumption choices that can lead to urban sprawl. In general, around the United States, the increase in per capita land consumption (Per Capita Sprawl) is an important cause of Overall Sprawl in many cities and counties. The NRI combined with Census data on the nation's Developed Land allow us to track trends in per capita land consumption from decade to decade.

At a minimum, the per capita land consumption figure reflects the combined outcome of all the following individual and institutional choices and factors:

- **Development**
  - Consumer preferences for size and type of housing and yards
  - Developer preferences for constructing housing, offices and retail facilities
  - Governmental subsidies that encourage land consumption, and fees and taxes that discourage consumption
  - Quality of urban planning and zoning
  - Level of affluence
  - Areal extent of the entire built-up urbanized land area comprised of non-residential land uses, such as industrial, institutional, government, commercial, etc.
- **Transportation**
  - Governmental subsidies and programs for highways, streets and mass transit
  - Consumer preferences favoring the mobility and flexibility offered by using private vehicles rather than public transit
  - Price of gasoline (cheap gas encourages sprawl)
- **Quality of existing communities and ability to hold onto their residents**
  - Quality of schools
  - Reality and perceptions concerning crime and safety
  - Ethnic and cultural tensions or harmony
  - Quality of government leadership
  - Job opportunities
  - Levels of pollution
  - Quality of parks, other public facilities and infrastructure
- **Number of people per household**
  - Marriage rate and average age for marriage
  - Divorce rate
  - Recent fertility rate
  - Level of independence of young adults
  - Level of affluence enabling single people to live separately

(H) METHODOLOGY FOR APPORTIONING SHARES OF SPRAWL

A methodology for quantifying the respective contributions of population growth and changes in per capita consumption of any type of resource use was outlined in a 1991 paper by physicist John Holdren ("Population and the Energy Problem." *Population and Environment*, Vol. 12, No. 3, Spring 1991). Although Dr. Holdren's 1991 paper dealt specifically with the role of population growth in propelling the increase in U.S. energy consumption, the same methodology can also be applied to many types of population and resource consumption analyses.

In the case of sprawl, the resource under consideration is rural land, namely the expansion over time in the total acreage of rural land urbanized or converted into developed land and subsequently used for urban purposes, such as for housing, commerce, retail, office space, education, light and heavy industry, transportation, and so forth.

As stated in Appendix B, the total land area developed in a city (urbanized area), county, or state can be expressed as:

(1) $A = P \times a$

Where:

A = Area of total are (in acres or square miles) of development in city or state
P = Population of that city or state
a = area of city or state used by the average resident (per capita land use)

Following the logic in Holdren's paper, if over a period of time Δt (e.g., a year or a decade), the population grows by an increment ΔP and the per capita land use changes by Δa, the total urbanized land area grows by ΔA, expressed as:

(2) $A + \Delta A = (P + \Delta P) \times (a + \Delta a)$

Subtracting eqn. (1) from eqn. (2) and dividing through by A to compute the relative change (i.e., $\Delta A/A$) in urbanized land area over time interval Δt yields:

(3) $\Delta A/A = \Delta P/P + \Delta a/a + (\Delta P/P) \times (\Delta a/a)$

Now equation (3) is quite general and makes no assumption about the growth model or time interval. On a year-to-year basis, the percentage increments in P and a are small (i.e., single digit percentages), so the second order term in equation (3) can be ignored. Hence following the Holdren paradigm, eqn. (3) states that the percentage growth in an urbanized land area or developed area of a country (viz., 100 percent x $\Delta A/A$) is the sum of the

percentage growth in the population (100 percent x $\Delta P/P$) plus the percentage growth in the per capita land use (100 percent x $\Delta a/a$). Stated in words, equation (3) becomes:

(4) *Overall percentage land area growth = Overall percentage population growth + Overall percentage per capita growth*

In essence, this apportioning methodology quantifies population growth's share of total land consumption (sprawl) by finding the ratio of the overall percentage change in population over a period of time to the overall percentage change in land area consumed for the same period. This can be expressed as:

(5) $$\textit{Population share of growth} = \frac{\textit{(Overall percentage population growth)}}{\textit{(Overall percentage land area growth)}}$$

The same form applies for per capita land use:

(6) $$\textit{Per capita land use share of growth} = \frac{\textit{(Overall \% per capita land use growth)}}{\textit{(Overall \% land area growth)}}$$

The above two equations follow the relationship based on Prof. Holdren's equation (5) in his 1991 paper. A common growth model follows the form (say for population):

(7) $$P(t) = P_0(1 + g_p)t$$

Where $P(t)$ is population at time t, P_0 is the initial population and g_p the growth rate over the interval. Solving for g_p the growth rate yields:

(8) $$\ln(1 + g_p) = (1/t) \ln(P(t)/P_0)$$

Since $\ln(1 + x)$ approximately equals x for small values of x, equation (8) can be written as:

(9) $$g_p = (1/t) \ln(P(t)/P_0)$$

The same form of derivation of growth rates can be written for land area (A) and per capita land use (a)

(10) $$g_A = (1/t) \ln(A(t)/A_0)$$

(11) $$g_a = (1/t) \ln(a(t)/a_0)$$

These three equations for the growth rates allow the result of equation (4) to be restated as:

(12) $$gP + g_a = g_A$$

Substituting the formulae (equations 9 through 11) for the growth rates and relating the initial and final values of the variables P, a and A over the period of interest into equation (12), the actual calculational relationship becomes:

(H) METHODOLOGY FOR APPORTIONING SHARES OF SPRAWL

(13) ln (*final population / initial population*) + ln (*final per capita land area / initial per capita land area*) = ln (*final total land area / initial total land area*)

In other words, the natural logarithm (ln) of the ratio of the final to initial population, plus the logarithm of the ratio of the final to initial per capita land area (i.e., land consumption per resident), equals the logarithm of the final to the initial total land area.

In the case of the United States (49 states) from 1982 to 2017, this formula would appear as:

(14) ln (323,550,993 *residents* / 230,580,652 *residents*) + ln (*0.358 acre per resident / 0.312 acre per resident*) = ln (*115,726,400 acres / 71,847,500 acres*)

Computing the ratios yields:

(15) ln (1.403) + ln (1.148) = ln (1.611)

0.339 + 0.138 = 0.477

Then, applying equations (5) and (6), the percentage contributions of population growth and per capita land area growth are obtained by dividing (i.e., normalizing to 100 percent) each side by 0.54381:

(16) $\frac{0.339}{0.477} + \frac{0.138}{0.477} = \frac{0.477}{0.477}$

Performing these divisions yields:

(17) 0.71 + 0.29 = 1.0

Thus, we note that in the case of the 49 states of the USA (all except Alaska) from 1982 to 2015, the share of sprawl due to population growth was 71 percent [100 percent x (0.339 / 0.477)], while declining density (i.e., an increase in land area per capita) accounted for 29 percent [100 percent x (0.138 / 0.477)]. Note that the sum of both percentages equals 100 percent.

In the main body of this report we modify this gross state-wide percentage of sprawl related to population growth by using a county-by-county weighting approach. This approach accounts for the sprawl that occurs in each county and applies a proportionately greater weight to those counties with greater amounts of sprawl. In essence, sprawl in counties around Flagstaff, Arizona for example, should not be attributed to population growth in counties around Phoenix or Tucson.

In this method, the amount of sprawl related to population growth in each county is summed for all of the counties each of the states. This sum or aggregate is then divided by the total amount of sprawl in the state. Using this procedure, by way of example, 92 percent of the sprawl in Texas between 1982 and 2015 was shown to be related to population growth, which the authors believe is a more accurate rendering of population growth's role than 113 percent, which

exaggerates population's role, and implies that all sprawl (and then some) in Texas during that period was related to population growth, which was not the case.
However, the opposite can also occur. That is, hypothetically, the weighted average for a state can also be greater than the gross state-wide percentage.

This is best illustrated by the State of West Virginia (p. D-293 in Appendix D), where the population did not grow from 1982 to 2017, but actually fell by seven percent. Because there was no population growth – indeed there was population decline instead – by our own terminology and procedures, population growth cannot have been related to any sprawl at all in West Virginia in the 1982 to 2017 time period. All sprawl in the state must have been associated with growth in per capita land consumption (i.e., declining population density).

Indeed, this is what is shown on p. D-293. The 827.3 square miles of sprawl in West Virginia from 1982-2017 was all related to declining per capita land consumption, or what we call Per Capita Sprawl. The right-most column, labeled "% Sprawl Related to Population Growth" shows "0", as it should according to our methodology.

However, it seems a bit absolutist or extreme to conclude that no sprawl at all in the state was related to population growth. How could this be, when individual county results for West Virginia show that population growth did account for some of their own sprawl?

For example, Berkeley County, WV sprawled by 83.4 square miles from 1982 to 2017, a 215% increase in the area of Developed Land. Its population also grew by 66,545, a 137% increase. Our calculations estimate that 75% of the sprawl in Berkeley County was due to population growth. However, if we examine West Virginia's counties only in the aggregate, these more "granular" results vanish, and that leads to an inaccurate and extreme conclusion that no sprawl at all in the entire state was related to population growth.

But if we add up the counties one by one, weighting them proportionately by how much sprawl and population growth occurred in each county individually, we can obtain a more accurate result for the state as a whole. This is shown in the bottom row of the table for West Virginia (p. D-293 in Appendix D), and indicates that approximately 18 percent of the sprawl (increase in area of Developed Land, or 827.3 square miles) in the state from 1982 to 2017 was related to population growth.

FEDERAL CONSERVATION AND POPULATION POLICIES AT ODDS

In May 2021, the Biden Administration formally released its grand "30x30" plan in a report called "Conserving and Restoring America the Beautiful." Co-authored by the U.S. Departments of Interior, Commerce, and Agriculture, along with the White House Council on Environmental Quality, the document characterizes itself stirringly as a "preliminary report to the National Climate Task Force recommending a ten-year, locally led campaign to conserve and restore the lands and waters upon which we all depend, and which bind us together as Americans."

The elevated public attention to habitat preservation is a welcome change from the basic disinterest shown during most of our two decades of publishing these sprawl studies. Among many threats to wildlife, including pollution, toxics, invasive species, road mortality, overhunting, or poaching, various studies have found habitat loss is the single most critical threat to the preservation of species.

Preserving natural areas is also important for the quality of life of humans. The presence of open space within and adjacent to our urban areas – and the assurance that this open space will outlast us – serves to counterbalance the stress and strain of modern life. Contact with nature and open space provides both physiological and psychological benefits.

Nonetheless, many of the same politicians and groups who are ambitiously calling for protecting 30 percent of the United States land area from development by 2030 are also advocating large increases in immigration that would swell the U.S. population even further.

Most fail to even recognize that U.S. population growth is a major factor in causing the loss of open space and natural habitat in the United States. The White House "30×30" plan, for example, does not have a single reference to U.S. population growth.

That approach doesn't work, according to Joseph Chaimie, former director of the United Nations Population Division. Writing in early 2022 in *The Hill,* a favorite publication for those who work in and around Congress, he stated: "If the United States intends to address climate change, biodiversity loss, pollution, etc., it must consider how its population affects each issue."

He lamented that federal officials for a half-century have ignored the recommendations of a bi-partisan federal commission in 1972 to stabilize the U.S. population to reduce pressures on the environment. That failure has had global demographic and environmental consequences. But the United States has a chance to redeem itself: "Gradually stabilizing America's population will provide an exemplary model for other countries to emulate. Rather than racing to increase the size of their respective populations in a world with 8 billion humans and growing, nations would see America moving away from the unsustainable demographic strategy," Chamie wrote.

Congress missed a similar opportunity a quarter-century ago, Gary Wockner wrote in the *Las Vegas Sun*. The Colorado-based, self-proclaimed "river warrior" recognized for efforts to save wild waterways in many countries decried the failure of federal officials to heed the conclusion in 1996 of President Clinton's Task Force on Population and Consumption that U.S. population stabilization is essential for environmental sustainability. "Time is running out, but we can make sure the next three decades don't mirror the past 30 years of population growth and environmental destruction," he wrote. "President Joe Biden has an opportunity to follow in Clinton's footsteps and finally implement the council's recommendations. Our most pristine and breathtaking places are worth protecting. But we won't be able to save them if our country keeps growing by leaps and bounds."

The United States has lost well over 20,000 square miles of natural habitat and farmland to development since we at the NumbersUSA Education and Research Foundation began our long series of sprawl studies in the year 2000. The losses have exceeded 35,000 square miles since 1996 when the economic, government, private sector, and environmental leaders on the Clinton task force called on the country to "move toward stabilizing the U.S. population."

At the time of the report, the U.S. population had exceeded **281 million**. The task force warned that if the country did not heed its recommendations, "U.S. population is likely to reach **350 million** by the year 2030; a level that would place even greater strain on our ability to increase prosperity, clean up pollution, alleviate congestion, manage sprawl, and reduce the overall consumption of resources."

(I) UNDERMINING THE 30X30 CONSERVATION VISION

Unfortunately, the task force's dismal warning is turning out to be largely precise. U.S. population has already exceeded **332 million** in 2022 and is headed for **355 million** by 2030, according to the Census Bureau. The imperiled natural habitat, species, and human communities are reviewed in the opening chapters of our study.

Today's urgent national efforts, such as the 30x30 movement, are based on changing the trajectory of open-space loss by 2030 without changing the trajectory of population growth. Echoing the conclusions of the Clinton task force, our latest national sprawl study finds that formula is highly unlikely to be successful.

The outlook for open-space conservation could be much more positive, however, if Congress Simply would follow the Clinton task force recommendation to adopt annual immigration numerical caps consistent with the goal of stabilizing the country's population size.

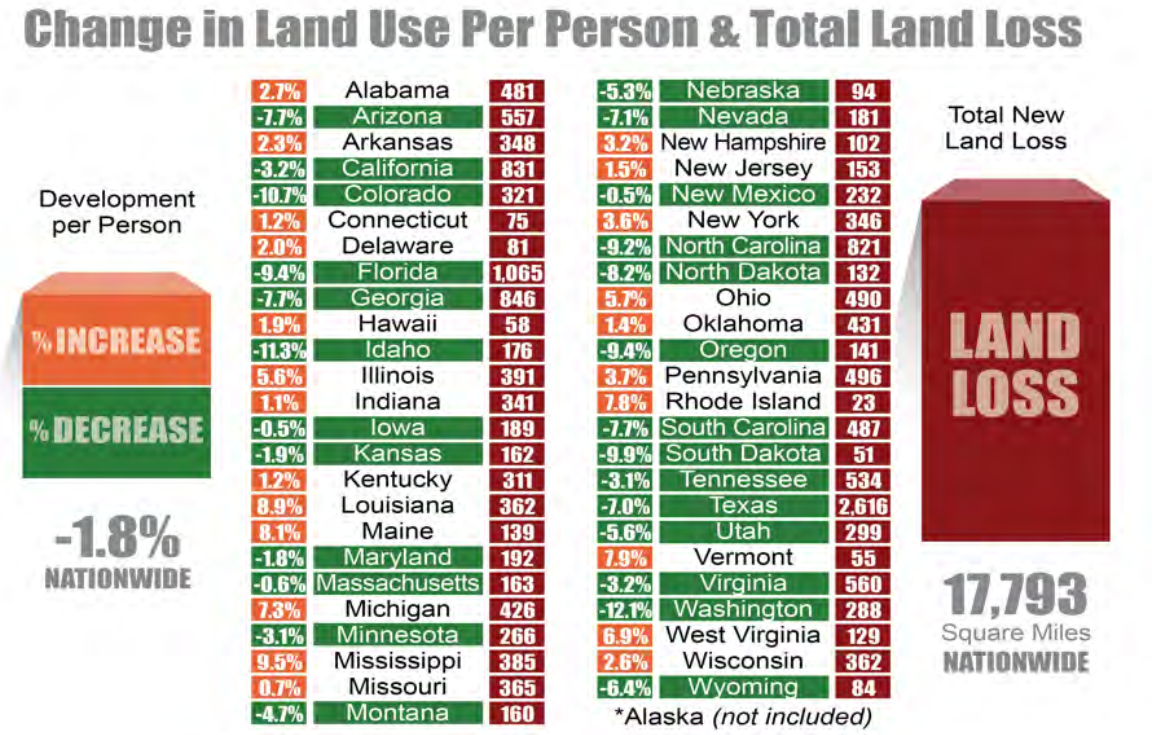
(J) DENSER LIVING DIDN'T STOP LOSS OF OPEN SPACE

In the United States, nearly all government efforts to combat sprawl have focused on strategies which primarily seek to create denser settlement by changing land use practices.

Our findings, however, indicate that approach will have limited success in saving rural land from development because it fails to address the key reason for current sprawl – population growth and its overwhelming driver, federal immigration policies. **Twenty-six states with declining development per resident** in the 2002-2017 period provided case studies for that proposition. The residents of those states lived, worked and shopped more densely than prior to 2002. How did that happen? Certainly, some role was played by so-called Smart Growth planning efforts, higher gasoline prices, fiscal and budgetary constraints (limiting new road-building, for example), the increasing popularity of denser city living (pre-Covid pandemic) and its cultural amenities, and the recession-inducing mortgage meltdown in 2008.

The extent to which any of those and still other unforeseen factors and events – such as the COVID-19 pandemic of 2020-2022 – may affect the rate of per capita sprawl in the coming decades is unknown and unpredictable. It may well be, for example, that concerns about high density residential living in the face of pandemics could increase sprawl pressures by raising the preference of consumers for lower-density suburban neighborhoods.

The 26 states with declining development per person are shown in the chart below with negative percentage numbers in green-shaded boxes. As you can see in the column next to them containing the square miles of lost rural land, all 26 states still sprawled over additional large areas of natural habitat and farmland. **The population growth in these states simply erased any land-conservation benefit of denser living and better planning.**



Change By State in Land Use Per Person & Total Land Loss (2002-2017)

(J) DENSER LIVING DIDN'T STOP LOSS OF OPEN SPACE

Even if all new population could somehow be added to cities without the cities expanding over any new ground, the additional people would still greatly increase the overall **ecological footprint** of the cities into rural areas. For example, U.S. residents in 2017 on average used or "consumed" 0.356 acre – a little over one-third of an acre – of developed land per resident. But that 0.356-acre/resident metric does not include relatively unpopulated rural lands – farmlands (cropland, pasture, and rangeland), forests, reservoirs, and mines – that furnish crucial raw materials and products used by every consumer/resident, namely for food, fiber, fuels, water, energy, metals, and minerals. Nor does the 0.356-acre of developed land include the forestlands needed to absorb each American resident's carbon dioxide (CO_2) emissions from fossil fuel combustion to produce electricity and propel our vehicles.

All of these ecologically productive lands not covered with pavement and buildings, but used indirectly by each and every U.S. resident (and all human consumers), contribute to the average per capita ecological footprint of each American. This entails approximately 20 acres per person, according to the Global Footprint Network.

https://www.youtube.com/watch?v=eb7L9j48IKot

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ROY BECK was one of the nation's first environment-beat newspaper reporters in the 1960s. A graduate of the University of Missouri School of Journalism, he won national recognition for his coverage of urban expansion issues. A former Washington bureau chief for a chain of daily newspapers, he is the author of five public policy books, including *Recharting America's Future*, and the latest, *Back of The Hiring Line: a 200-year history of immigration surges, employer bias, and depression of Black wealth*. His articles have appeared in scores of magazines, newspapers and journals. He has lectured widely on the ethical aspects of U.S. population issues and testified before Congress on many occasions. He has co-authored more than a dozen studies on sprawl in the last two decades. He founded NumbersUSA in 1996 to educate the public on the recommendations of two federal commissions on population and environmental sustainability and on economic justice.

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