

## PRRIP COHYST AREA Livestock Population Analysis

### Livestock Population Data.

Livestock data for the COHYST and associated areas was obtained from the National Agricultural Statistic Service and Agricultural Census. The data was organized into county subsets. Agricultural Statistics data were available for cattle for each year from 1992 to 2007 in each county. Ag Stats data for cattle was complete. There were no data voids.

Agricultural Statistics data were available for hogs and pigs only for the years 1995-1998. Because of the narrow window of data, his data was not used in subsequent analysis. Agricultural Census reported data for hogs, horses, sheep, and poultry for the years 1992, 1997, 2002, and 2007 (The 2007 data set was mostly empty). The Census data for hogs was incomplete. There were zero values for different counties in different years. In some years there were more zeros than in others. Census data for poultry had missing information, more so in 1992. Poultry represented a significant fraction of the total livestock and so was included in analysis

Census data for horses was fairly complete. Census data for sheep had many zero values. Both horses and sheep represented such a small fraction of the total livestock population that they were not included in subsequent analysis.

### Livestock Population estimates.

The yearly livestock populations were estimated for the COHYST area, the Over-appropriated area, and for the fraction of the Natural Resources Districts within the boundaries of the COHYST area and the Over-appropriated area using the Agricultural Statistics and Agricultural Census data. Populations were apportioned to these regions from the county data. A basic assumption used in this approach is that the livestock population is distributed evenly throughout the county.

### Yearly population totals.

The yearly population estimates for the COHYST area were calculated as follows; The COHYST area covers all or part of 43 counties in Nebraska. The fraction of each county within the COHYST area was determined by overlay analysis in a GIS. The COHYST population was determined by multiplying the total population of particular county times the fraction of that county that is in the COHYST area and accumulating these estimates over all of the counties within the COHYST area. Estimates were calculated for the Over-appropriated area using similar techniques.

### Yearly population totals, NRD Subsets

The yearly population estimates for NRDs within the COHYST area were calculated as follows; The COHYST area covers all or part of 43 counties in Nebraska. The fraction of each county within the COHYST area was determined by overlay analysis in a GIS. In a second overly step, the fraction of each county within a particular NRD was determined. The COHYST by NRD population was determined by multiplying the total population of particular county times the fraction of that county that is both in the NRD and in the COHYST area and accumulating these estimates over all of the counties within the COHYST area. Estimates were calculated for NRDs within the Over-appropriated area using similar techniques.

### Population averaged over the period of interest.

The average annual population for each species was calculated using all available data. The percentage of the total livestock population that is represented by the particular species was calculated to assess the impact of these species on consumptive use of water. Cattle and hogs make up the bulk of the livestock. Poultry may contribute significantly to consumptive use. Horse and sheep populations represent less than 1% of the total livestock in the COHYST area.

## PRRIP COHYST AREA Livestock Population Analysis

Cattle represent approximately 71% of the total livestock relative to the 5 species analyzed. For simplification, the other species populations (hogs, poultry, sheep, horses) were normalized to a cattle-equivalent based on each species consumptive use of water relative to that of cattle. This conversion was completed by multiplying the population of each species by the following conversion factors:

Livestock Class	Daily Use Rate	Conversions Calculations (X)
Cattle	7 gallons	1
Hogs	4 gallons	$4/7*100 = 0.57$
Horse	12 gallons	$12/7*100 = 1.71$
Poultry	12 gallons/100 head	$12/7*100 = 1.71$
Sheep	4 gallons	$4/7*100 = 0.57$

These conversions are then calculated to find out the percentages of total represented by each species and to compare the livestock's water use for each individual animal class for all the counties.

### Normalized population averaged over the period of interest.

The average annual population for each species, after conversion, was calculated using all available data. The percentage of the total livestock population that is represented by the particular species was calculated to assess the impact of these species on consumptive use of water. Cattle and hogs make up the bulk of the livestock. Poultry may contribute significantly to consumptive use. Horse and sheep populations represent approximately 1%, respectively, of the total livestock in the COHYST area and were not used in subsequent analysis.

Four base layers:

1. Nebraska Counties from TIGER – (SDE)
2. Nebraska Natural Resources Districts – (SDE)
3. COHYST boundary – (?)
4. Over-Appropriated Area boundary – (?)

### COHYST livestock populations.

Identity Analysis in ArcGIS.

An area field (SQmile) was added to the County and COHYST feature classes and the area of each polygon was calculated in square miles for each feature class. An identity analysis was run with the County and the COHYST feature classes resulting in a feature class that had county and COHYST fields. The fraction of each county was calculated as:

$$\text{Fraction of county in COHYST} = \text{Area of county in COHYST} / \text{Total area of county}$$

### **Population Analysis Results for the COHYST Model Area:**

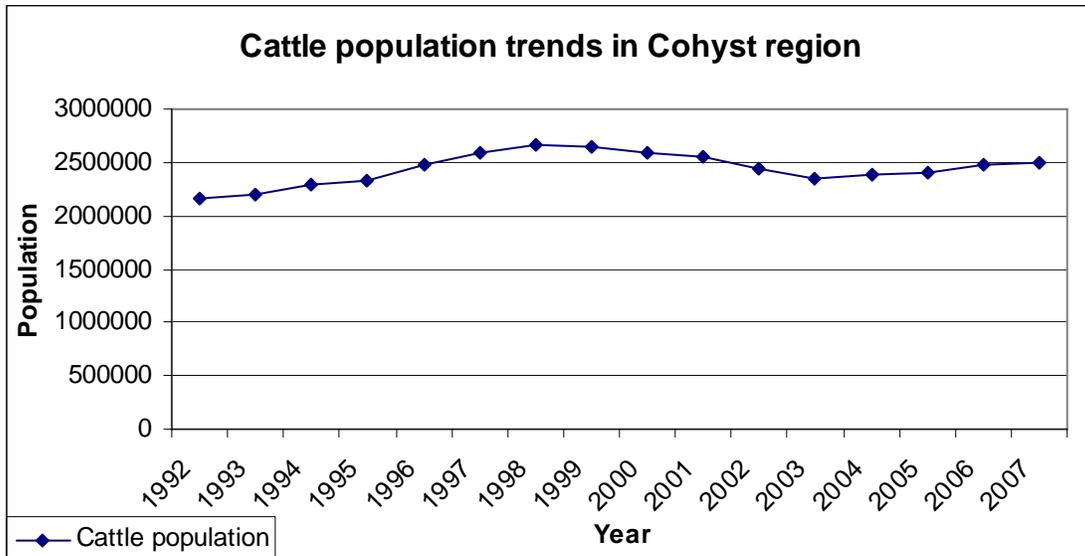
Hogs and poultry population data was only available for the years 1992, 1997, and 2002. Total normalized populations (includes hogs and poultry) are only possible for these years. The livestock population in the COHYST area for 1992 was 2,690,975, for 1997 was 3,332,178 and for 2002 was 3,613,012. The average population over these three years was 3,212,055.

Cattle population data were used to represent livestock population trends since the dataset was incomplete for all species other than cattle.

PRRIP COHYST AREA Livestock Population Analysis

County	Cattle 1992	Hogs 1992	Poultry 1992	Cattle 1997	Hogs 1997	Poultry 1997	Cattle 2002	Hogs 2002	Poultry 2002
Adams	78000	10720	0	77000	8108	1146	55000	9285	513
Arthur	29700	0	74	34200	0	172	29700	0	0
Banner	27000	842	0	38000	0	174	48000	0	181
Box Butte	39680	991	0	53760	390	367	54400	161	429
Buffalo	82720	23050	936	102080	13021	993	93280	6294	1156
Chase	36720	4582	220	40800	2160	153	46240	0	140
Cheyenne	53000	4965	0	68000	4921	308	56000	0	275
Clay	65000	85721	1259	72000	70002	255	60000	85857	559
Custer	52800	6861	779	68400	8610	643	67680	7731	586
Dawson	210000	42014	2102	250000	24463	1606	240000	17865	1742
Deuel	12000	1514	180	11000	1163	0	14000	11	0
Franklin	32390	6220	0	35550	3629	308	31600	472	317
Frontier	52000	8385	1488	72000	3392	1366	60000	0	681
Furnas	11000	10467	0	11660	6832	85	10560	0	36
Garden	50000	3093	684	85000	0	253	76000	9	410
Gosper	33000	8010	262	36000	23004	75	28000	0	120
Grant	7310	0	0	7140	0	17	6460	0	24
Hall	74000	21121	2721	80000	19204	1014	77000	2704	1165
Hamilton	37000	25877	2009	42000	21326	1161	44000	10931	708
Harlan	32640	5227	0	39440	2903	530	27200	1150	394
Hayes	47040	4004	410	53760	2117	190	49920	439	279
Hitchcock	4620	1131	398	4900	464	134	4480	205	70
Howard	18000	6243	1429	21900	4369	368	22800	2266	350
Kearney	65000	15982	575	85000	11263	157	83000	6537	829
Keith	67000	1097	0	78000	0	744	64000	0	443
Kimball	21000	2448	0	23000	718	332	19000	404	154
Lincoln	157000	12910	1606	189000	9501	1117	210000	4900	1101
Logan	9180	573	0	9720	526	23	9180	0	33
McPherson	18700	833	292	20900	0	193	23100	0	96
Merrick	74000	23510	1383	81000	17791	805	66000	12191	580
Morrill	104000	1457	848	135000	1089	414	156000	337	636
Nance	10560	4230	0	10320	4836	306	8640	4153	231
Nuckolls	38000	26971	3629	37000	14935	426	34000	7127	457
Perkins	23000	2269	0	28000	1223	308	26000	0	742
Phelps	120000	13115	0	158000	14328	703	162000	8764	356
Platte	9360	14368	1144	11050	13540	255	10400	14070	72
Polk	57000	28318	0	65000	29551	320088	60000	26061	879005
Red Willow	20900	4983	0	22420	3483	287	22800	1863	141
Scotts Bluff	140000	7188	0	150000	4624	809	130000	2167	773
Sheridan	19680	861	309	21920	420	214	19680	306	163
Sioux	26600	1318	456	33820	0	401	34960	0	385
Webster	52650	12191	0	63180	22418	533	51840	13518	249
York	45000	45875	0	60000	35502	0	54000	21734	0
Total	2164250	501534	25191	2586920	405826	339432	2446920	269510	896581

Year	Total Livestock =Cattle+Hogs+Poultry
1992	2690975
1997	3332178
2002	3613012



The cattle population increased to a high of 2,665,970 in 1998, decreased to 2,347,900 in the year 2003. Population began to increase from 2003 to 2007 but did not reach 1997 levels.

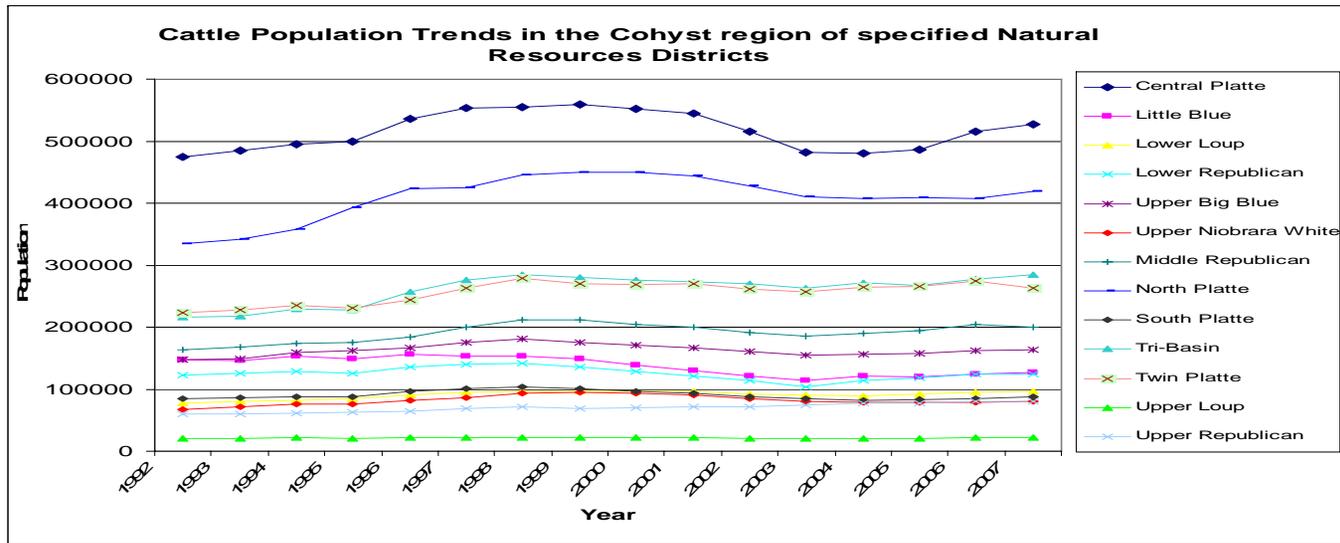
**Population Analysis Results for Natural Resources Districts in the COHYST Model Area:**

The following table lists the normalized population estimates for the area of individual NRDs that lies within the COHYST model area:

NRDs	1992	1997	2002	Average
Central Platte	606882	782235	938418	<b>775845</b>
Little Blue	230475	218316	188357	<b>212383</b>
Lower Loup	106467	119373	111193	<b>112344</b>
Lower Republican	161217	173679	127855	<b>154250</b>
Upper Big Blue	272975	463820	754617	<b>497137</b>
Upper Niobrara White	70592	87925	86372	<b>81630</b>
Middle Republican	188073	214258	195778	<b>199370</b>
North Platte	349681	432822	432692	<b>405065</b>
South Platte	94155	108348	88945	<b>97149</b>
Tri Basin	253384	325245	286710	<b>288446</b>
Twin Platte	235821	272161	266732	<b>258238</b>
Upper Loup	21319	21991	20799	<b>21370</b>
Upper Republican	66538	72349	72854	<b>70581</b>
<b>Total</b>	<b>2657579</b>	<b>3292521</b>	<b>3571323</b>	

The cattle populations for each of the NRDs followed the general trend of rising population during the 1998 to 2000 period, falling population until about 2003 and then a small rise to 2007. The low point occurred from 2001 to 2006 and then started increasing from year 2007 but did not reach the count as in the year 1997. The Central Platte and the North Platte NRDs each encompass counties with large cattle populations. The cattle population swings in these NRDs was more pronounced

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Cattle Population in the COHYST Region within NRD's for years 1992-2007

NRDs	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Central Platte	473830	484640	495050	498620	535980	552560	554060	559460	551700	545030	516030	482020	479610	486580	515090	527080
Little Blue	147000	145590	153420	149580	156300	152690	152560	148280	138400	129570	121170	113340	121670	119970	123770	126310
Lower Loup	77760	80360	82300	84850	90560	95420	96340	96690	96260	95880	91420	89890	88910	91400	95620	96720
Lower Republican	122170	126060	128790	125490	136360	139460	142110	135430	128820	121000	113820	103670	113650	117600	123420	123740
Upper Big Blue	147940	149510	159540	162290	166370	174800	180790	174500	170640	166240	160100	155040	156860	157520	161370	164130
Upper Niobrara White	67840	71680	75210	75590	81930	86410	93630	94230	94060	91210	85190	80740	78290	79150	78160	80710
Middle Republican	163990	168420	174030	174670	184610	200290	211840	211500	204100	199400	190580	186130	189420	193610	203760	200020
North Platte	334590	341490	358290	393210	423120	425280	444780	448980	448980	444030	427980	410940	407700	408210	407250	418890
South Platte	85140	86130	88110	88110	97020	100980	102960	100980	97020	93060	88110	84150	81180	83160	85140	87120
Tri Basin	215820	217800	228690	227700	256410	276210	285120	280170	275220	273240	270270	263340	272250	267300	277200	284130
Twin Platte	223350	227310	235440	231270	243510	263460	278940	270210	268200	269790	261900	257280	264300	265380	274590	262170
Upper Loup	20480	20480	21490	20750	21400	21380	21400	21340	21310	21440	20720	20260	20310	20900	21680	21800
Upper Republican	59490	59180	61530	63200	64560	68520	71180	69140	69880	71610	71980	74700	76740	77730	80390	80450
<b>Total</b>	<b>2139400</b>	<b>2178650</b>	<b>2261890</b>	<b>2295330</b>	<b>2458130</b>	<b>2557460</b>	<b>2635710</b>	<b>2610910</b>	<b>2564590</b>	<b>2521500</b>	<b>2419270</b>	<b>2321500</b>	<b>2350890</b>	<b>2368510</b>	<b>2447440</b>	<b>2473270</b>

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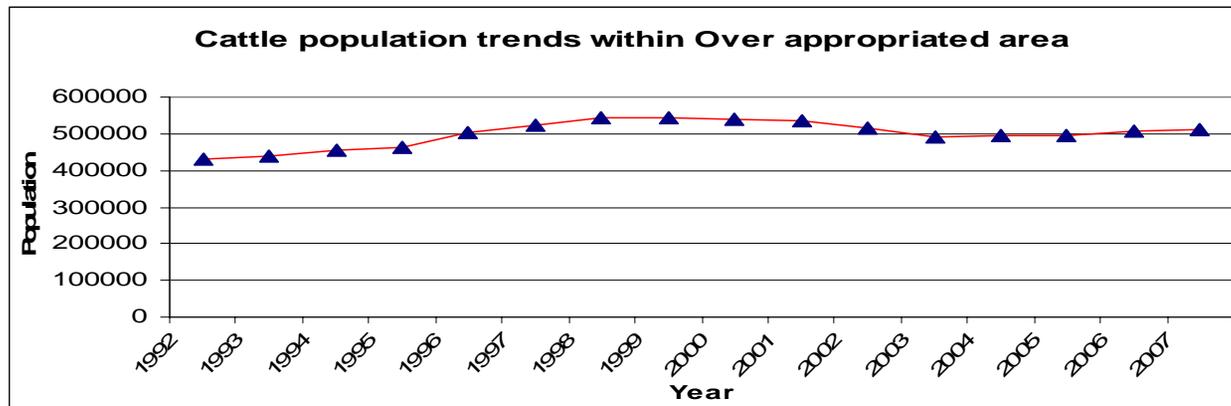
**Population Analysis Results for the Over-appropriated Area:**

Hogs and poultry population data was only available for the years 1992, 1997, and 2002. Total normalized populations (includes hogs and poultry) are only possible for these years. The livestock population in the Over-appropriated area for 1992 was 469296 for 1997 was 552575 and for 2002 was 529937. The average population over these three years was 517269.

Table: Population Trends within OA for years 1992, 1997 and 2002

County name	Cattle92	Hogs92	Poultry92	Cattle97	Hogs97	Poultry97	Cattle02	Hogs02	Poultry02
Banner	17280	539	0	24320	0	112	30720	0	116
Buffalo	940	262	11	1160	148	11	1060	72	13
Cheyenne	10070	943	0	12920	935	58	10640	0	52
Dawson	67200	13445	673	80000	7828	514	76800	5717	558
Deuel	2880	363	43	2640	279	0	3360	3	0
Garden	13000	804	178	22100	0	66	19760	2	107
Gosper	9240	2243	73	10080	6441	21	7840	0	34
Keith	48240	790	0	56160	0	536	46080	0	319
Kimball	2520	294	0	2760	86	40	2280	48	18
Lincoln	62800	5164	642	75600	3801	447	84000	1960	440
McPherson	6120	273	96	6840	0	63	7560	0	31
Morrill	48880	685	399	63450	512	194	73320	158	299
Phelps	39600	4328	0	52140	4728	232	53460	2892	117
Scotts Bluff	96600	4960	0	103500	3190	558	89700	1495	533
Sioux	6300	312	108	8010	0	95	8280	0	91
<b>Total</b>	<b>431670</b>	<b>35404</b>	<b>2222</b>	<b>521680</b>	<b>27948</b>	<b>2947</b>	<b>514860</b>	<b>12347</b>	<b>2729</b>

Cattle population data were used to represent livestock population trends since the dataset was incomplete for all species other than cattle.



PRRIP COHYST AREA Livestock Population Analysis

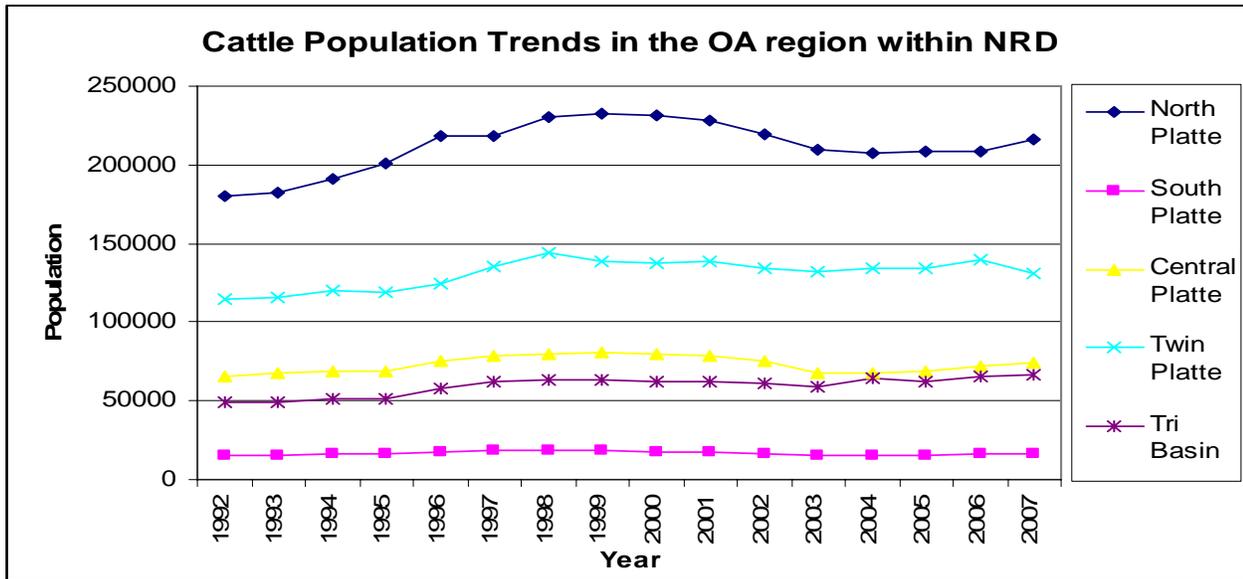
Table: Cattle Population Trends within Over-appropriated area

County name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Banner	17280	18560	19840	21120	23040	24320	28160	28800	30080	30720	30720	30080	30720	32640	33280	32640
Buffalo	940	1000	1030	1060	1150	1160	1160	1180	1160	1140	1060	1030	1010	1020	1100	1070
Cheyenne	10070	10640	10640	11020	12540	12920	13110	12920	12350	11590	10640	10070	9500	10070	10070	9880
Dawson	67200	68800	69760	70400	76800	80000	80960	81920	80640	80320	76800	68800	68800	69440	72960	75200
Deuel	2880	2640	2640	2400	2400	2640	2880	2880	2880	3120	3360	3480	3480	3360	3600	3840
Garden	13000	13000	13520	21840	21840	22100	21840	21580	21320	20800	19760	18720	18200	17420	17940	17680
Gosper	9240	9800	10360	10080	10080	10080	9240	9240	8960	8400	7840	7280	8120	7840	8400	8120
Keith	48240	48240	50400	49680	54000	56160	57600	54000	51840	49680	46080	41760	40320	38880	39600	38160
Kimball	2520	2400	2640	2520	2640	2760	2760	2640	2520	2400	2280	2100	2100	2040	2160	2400
Lincoln	62800	64000	66400	65600	67600	75600	82400	80800	81600	84400	84000	86000	90000	91200	96000	88000
McPherson	6120	6120	6480	6120	6120	6840	7380	7380	7560	7740	7560	7740	7740	7740	7560	8100
Morrill	48880	54050	56400	58750	63920	63450	65800	68620	70970	72850	73320	74260	74260	75670	73320	75670
Phelps	39600	39600	41250	41250	47850	52140	54450	54120	53790	53790	53460	52140	55770	54120	56760	58410
Scotts Bluff	96600	91770	96600	94530	104880	103500	109020	107640	103500	97980	89700	80730	78660	77280	78660	84870
Sioux	6300	6660	7020	6750	7200	8010	8640	8730	8730	8730	8280	7830	8100	7920	7560	7470
<b>Total</b>	<b>431670</b>	<b>437280</b>	<b>454980</b>	<b>463120</b>	<b>502060</b>	<b>521680</b>	<b>545400</b>	<b>542450</b>	<b>537900</b>	<b>533660</b>	<b>514860</b>	<b>492020</b>	<b>496780</b>	<b>496640</b>	<b>508970</b>	<b>511510</b>

The total cattle population in the over-appropriated area for year 1997 was 545,856. The population increased slightly until approximately 1999. Population decreased from 2000 to 2002. Population begins to increase in 2003 but does not reach 1997 levels by 2007.

Table: Cattle Population Trends in Over-appropriated area with NRDs.

NRD Districts	1992	1997	2002
North Platte	187756	223319	222007
South Platte	17114	19719	16402
Central Platte	79988	86900	81623
Twin Platte	121368	140279	137164
Tri Basin	55484	73642	64343
<b>Total</b>	<b>461,710</b>	<b>543,859</b>	<b>521,539</b>



The cattle populations for each of the NRDs in the Over-appropriated area followed the general trend of rising population during the 1998 to 2000 period, falling population until about 2003 /2004 and then a small rise to 2007. Relatively larger portions of the Over-Appropriated area are in the North Platte and Twin Platte NRDs, both of which encompass counties with large cattle populations. The cattle population increases and decreases were more pronounced in the North Platte NRD.

**Population by Region Analysis**  
**Detailed Process**

Overlay analysis to determine population and distribution of livestock in the COHYST, and Over-appropriated areas of Nebraska

Spatial analysis involved 4 shapefiles:

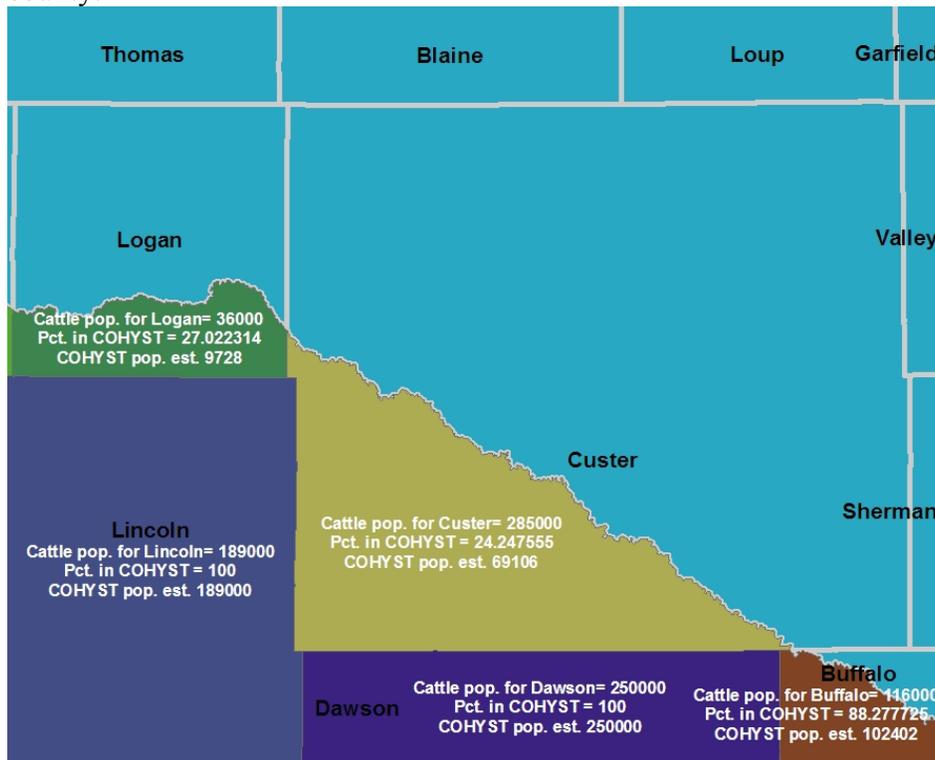
- Nebraska Counties
- Nebraska Natural Resources Districts
- COHYST area
- Over-appropriated area.

Shapefiles were prepared for analysis as follows:

- Square miles attribute added
- Square miles calculated using calculate geometry function

COHYST area population totals analysis

Identity function was used to determine the area of each county that is in the COHYST area. A second square miles field was added to the identity feature class and the square miles value for each new polygon was calculated using the calculation geometry function. The fraction of each county within COHYST was calculated by dividing the area of each county within COHYST by the total area of the county.



Livestock populations in specified counties within the COHYST area are calculated by multiplying the fraction of that county within the COHYST area times the number of livestock (i.e. cattle) in the county.

## PRRIP COHYST AREA Livestock Population Analysis

Cattle population in the COHYST was calculated by accumulating the COHYST county cattle populations over all of the counties in the COHYST area.

$Mi^2_X$  = Area of county X in square miles

$Mi^2_{X-COHYST}$  = Area of county X within the COHYST area

$Frac_X$  = fraction of county X in the COHYST area =  $Mi^2_{X-COHYST} / Mi^2_X$

$Pop_{CattleX}$  = population of cattle in county X

$Pop_{CattleX-COHYST}$  = population of cattle in the COHYST area of county X

COHYST cattle population =  $\sum Pop_{CattleX-COHYST}$  for all counties in the COHYST area

Similar techniques were used to determine livestock populations within the Over-appropriated area.

Overlay analysis to determine population and distribution of livestock in the COHYST, and Over-appropriated areas of Nebraska by Natural Resources District.

Spatial analysis involved 4 shapefiles:

- Nebraska Counties
- Nebraska Natural Resources Districts
- COHYST area
- Over-appropriated area.

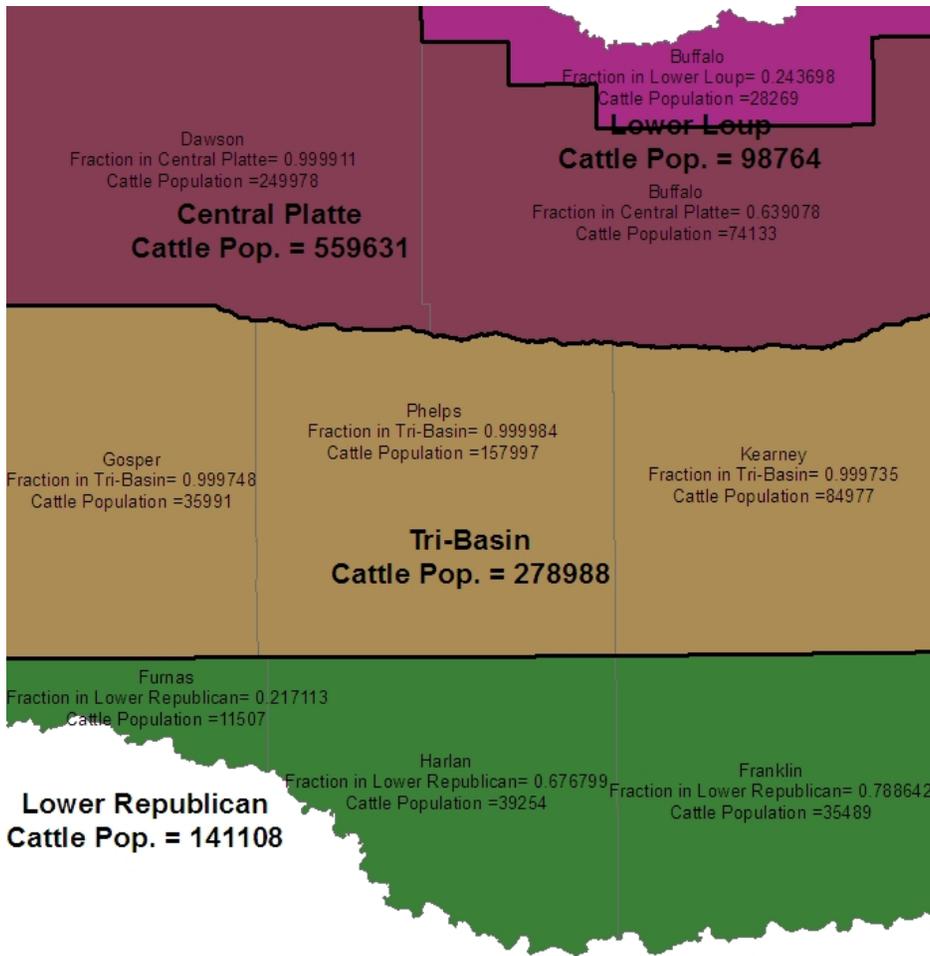
Shapefiles were prepared for analysis as follows:

- Square miles attribute added
- Square miles calculated using calculate geometry function

### COHYST area NRD population totals analysis

Natural Resources District feature class was clipped by the COHYST boundary. Identity function was used to determine the fraction of a particular county that resides in the COHYST portion of each NRD.

PRRIP COHYST AREA Livestock Population Analysis



$Mi^2_X$  = Area of county X in square miles

$Mi^2_{X-Y-COHYST}$  = Area of county X within NRD Y within the COHYST area

$Frac_{X,Y}$  = fraction of county X within NRD Y in the COHYST area  
 $= Mi^2_{X-Y-COHYST} / Mi^2_X$

$Pop_{CattleX}$  = population of cattle in county X

$Pop_{CattleX-Y-COHYST}$  = population of cattle in the COHYST area of county X

COHYST NRD cattle populations =  $\sum Pop_{CattleX-Y-COHYST}$  for all counties in the NRD area that is inside the COHYST area