THE HISTORY AND CAUSES OF EQUINE ABUSE AND NEGLECT: A Statistical Analysis

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Introduction

The factors contributing to equine abuse and neglect have long been debated, but rarely studied. It has been commonly assumed that abuse and neglect was simply an intractable and perennial problem, with little or no solution except for the disposal of excess horses through slaughter. This study finds that conventional wisdom to be completely wrong.

Many in the equine community expected that a 2011 GAO report[i] on the consequences of halting domestic slaughter would contain a statistical review of the recent history of the issue and provide meaningful insight. It did neither.

This study presents data obtained from state animal industry officials documenting the number of cases of legal action taken on issues of equine abuse and neglect, and explores correlations between trends and three possible factors:

- The number of US horses slaughtered
- The state unemployment rate
- The price of hay in the state

Daniel Patrick Moynihan famously said "Everyone is entitled to his own opinion, but not his own facts." This study will offer no opinions, but simply allow the facts to speak for themselves.

Methodology

Abuse and neglect data was obtained from state officials in terms of cases per year. These numbers were, of course, proportional to each state's equine population. Therefore, to present the data in a more consistent format from state to state, the number of cases in each year was divided by the state's estimated equine population as reported in the year 2005 in an American Horse Council[(ii)] survey. The resulting data was then presented in cases per 1000 head.
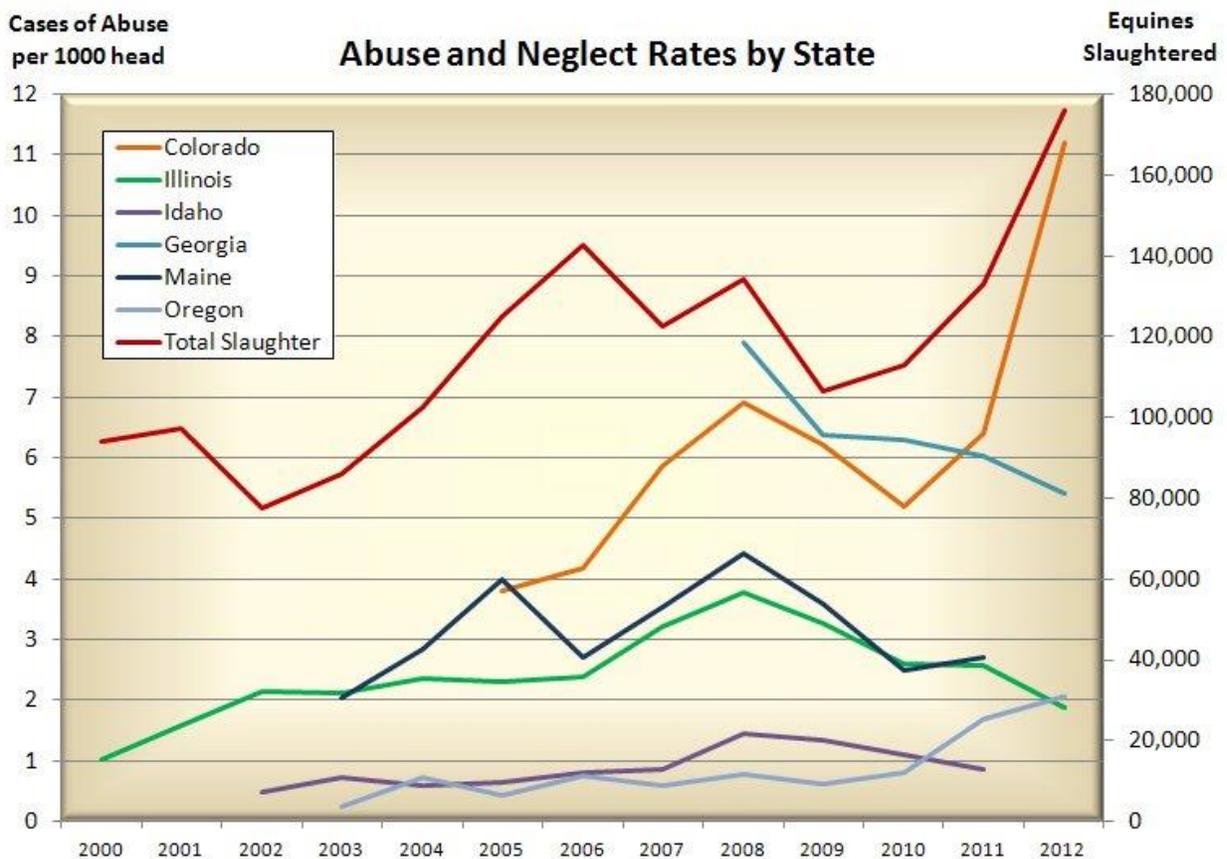

Figure 1 – History of Abuse and Neglect Rates

Most states delegate abuse investigations to either the localities (sheriff, police, etc.) or they empower a state humane organization/s to provide the enforcement of humane laws. Of the states that kept records, most did not have data for the entire period. Even so, enough data was gathered to show some compelling relationships.

To compare the influence of the three suspect causes, data was extracted from multiple government sources. Monthly unemployment data was downloaded from the Bureau of Labor Statistics[(iii)] and condensed into yearly averages for comparison to the abuse data.

Likewise, hay prices at the state level were downloaded from the National Agricultural Statistics Service using its "Quick Stats Lite" application[iv]. This application provided yearly totals for all hay production in dollars and tons. The price per ton was calculated by dividing the production value by the tonnage for each year and each state.
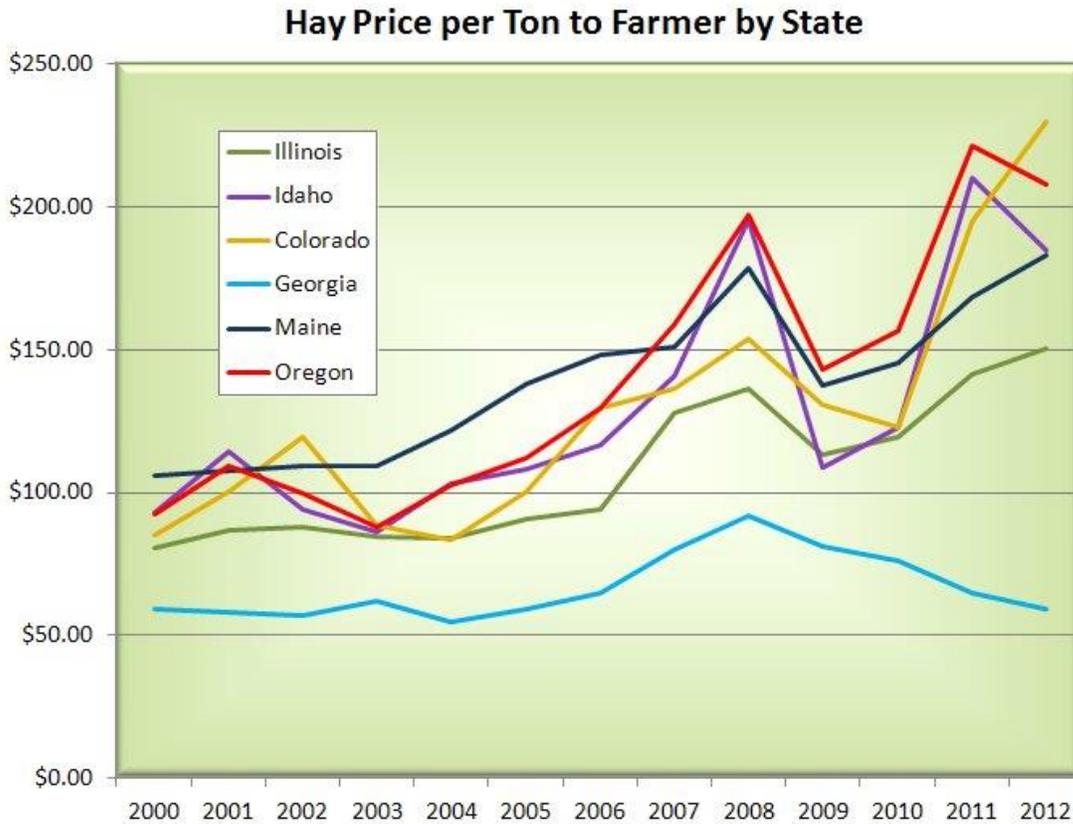
Hay Price per Ton to Farmer by State

Figure 2 - Hay Prices for States Studied

Equine slaughter statistics were compiled from web sites hosted by the USDA[v]. This data has been aggregated over many years. Figure 3 shows this data broken out by year and place of slaughter. The total for each year was used to produce the "Total Slaughter" curve in Figure 1.

An initial look at the data yields the first revelation. With the exception of Colorado and Oregon, the rate of abuse and neglect (Figure 1) has been in general decline since 2008. In fact, abuse rates in these states appear to now have returned to the level seen in 2006, and thus before the closing of the domestic horse slaughter plants and the economic crisis.

A second observation is that hay prices show some remarkable similarities to the abuse curves, with every state showing a peak in 2008 and a general increase from 2010 through 2012. It is also unusual to see the operational costs for any industry exhibit this level of inflation.

Certain historical events bear mentioning. On Easter Sunday of 2002, the Cavel plant in Illinois burned to the ground. The cause of the fire was not, as stated in the GAO report, the result of arson by animal rights extremists, but rather from undetermined causes. The plant was rebuilt and put back in operation in mid-2004. This accounts for the dip in slaughter numbers during this period.
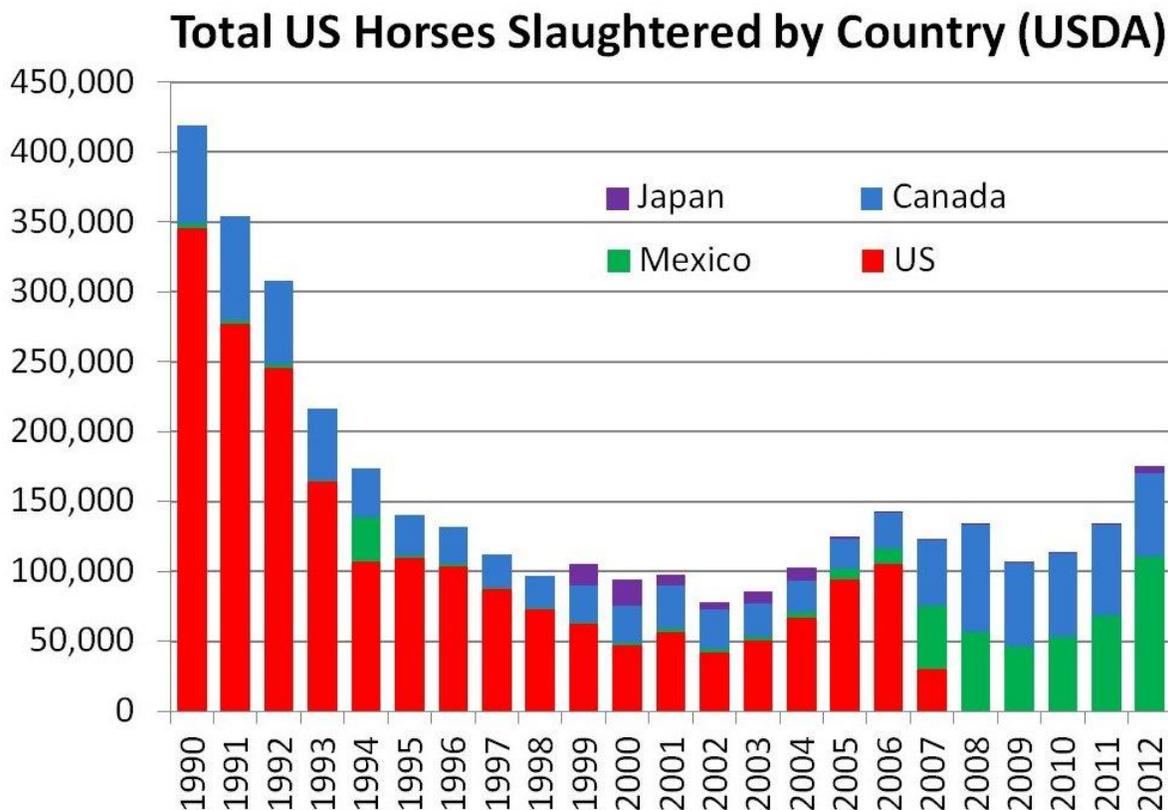
Total US Horses Slaughtered by Country (USDA)

Figure 3 - US Horses Slaughtered by Year and Country

In 2007, the three remaining horse slaughter plants in the US were shut down after a series of state legislative and legal actions. There was only a slight dip in horse slaughter as the plants immediately moved operations over the borders into Canada and Mexico. These closures had no real impact on the total number of horses being slaughtered as the companies simply shifted operations over the borders to Canada and Mexico as shown in Figure 3 - US Horses Slaughtered by Year and Country.

When two or more factors are at play it is impossible to quantify which factors are having the most affect on abuse and neglect by simply staring at such a presentation of the data. For that reason, the rate of abuse and neglect will be displayed against each of the three suspect causes for each state.

Note that for correlation purposes only the "X/Y" points themselves are of importance, not the sequence in which they occurred. For reference sake however,

we have elected to display the points as lying on a blue time line from the earliest to the latest.

If only one factor was overwhelmingly dominant, then its graph would be a straight line (though the time line might double back over itself in the sequence). More of the factor being tested would create proportionally more or less neglect, depending on whether it was a positive or negative correlation. Proponents of horse slaughter have long maintained that it prevents abuse and neglect. If this were so, the correlation between slaughter and abuse would be a negative one.

However other factors act to distort the actual line (set of data point pairs), causing bulges and even loops in its shape. Wide deep bulges or loops in these lines (e.g. Figure 11) indicate a strong influence by one or more other parameters, while tight small curves and even loops (e.g. Figure 6) indicate a lesser influence by other factors.

Quantifying the closeness with which points lie to a single straight line can be done with a popular statistical algorithm called the *Pearson Correlation Coefficient*[vi]. The coefficient is derived from the following formula:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\,n\Sigma x^2 - (\Sigma x)^2\,]\,[\,n\Sigma y^2 - (\Sigma y)^2\,]}}$$

Fortunately, long hand calculation is not necessary as this algorithm is built into Excel as an available function. To check the validity, however, the author wrote an algorithm in Visual Basic Net (Appendix I), and found it delivered identical results to the Excel version.

Multiple sets of X/Y values are entered, and the Pearson Coefficient is returned as a number between -1 and +1. A value of zero would indicate no correlation whatsoever; while a +1 would represent a perfect positive correlation (more X yields more Y or vice versa) and a -1 would represent a perfect negative correlation (more X yields less Y or vice versa).

It is important to understand that the Pearson Coefficient does not tell us *how much* one value affects the other, merely how predictable the relationship is. For the implied magnitude of the relationship (e.g. how much a dollar increase in hay cost affects the rate of neglect), another built in feature of Excel was used: the trend line.

For purposes of ranking the three suspect causes of neglect, only the Pearson Coefficient will be used.

Colorado

There is a striking similarity between the contours of the curves for Illinois, Georgia and Idaho. In fact, until 2010, Colorado was following much the same pattern. Then suddenly in 2010, the rate of neglect in Colorado skyrocketed (Figure 1).
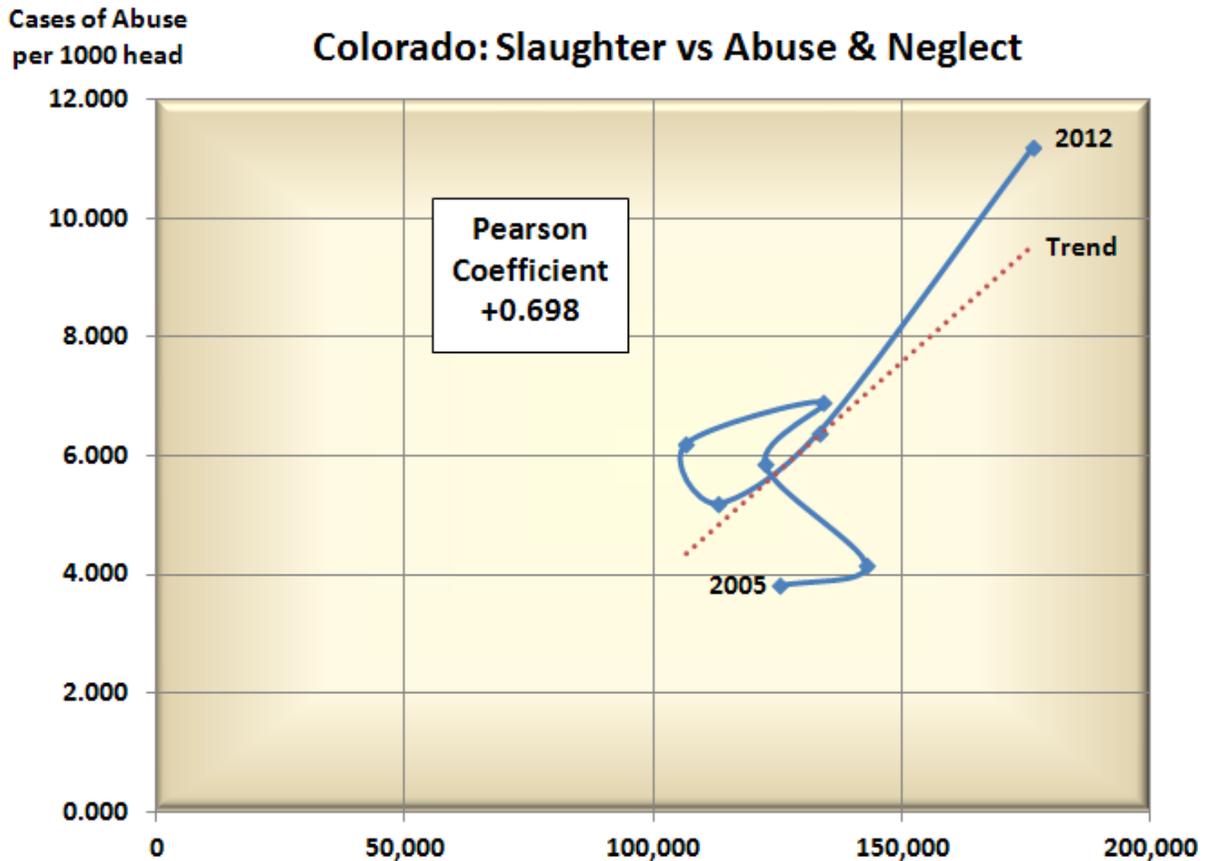
Cases of Abuse per 1000 head

Colorado: Slaughter vs Abuse & Neglect

Pearson Coefficient +0.698

2012

Trend

2005

Figure 4 - Slaughter vs. Abuse and Neglect in Colorado

The apparent positive (exacerbating) correlation between the rate of slaughter and neglect in Colorado is strong, as could be seen in Figure 1 when both slaughter and neglect turned up sharply in 2010. This generates a modestly strong positive Pearson Coefficient and implies that *more slaughter is associated with more abuse and neglect.* A single state with so few data points, however, has a wide margin of error.
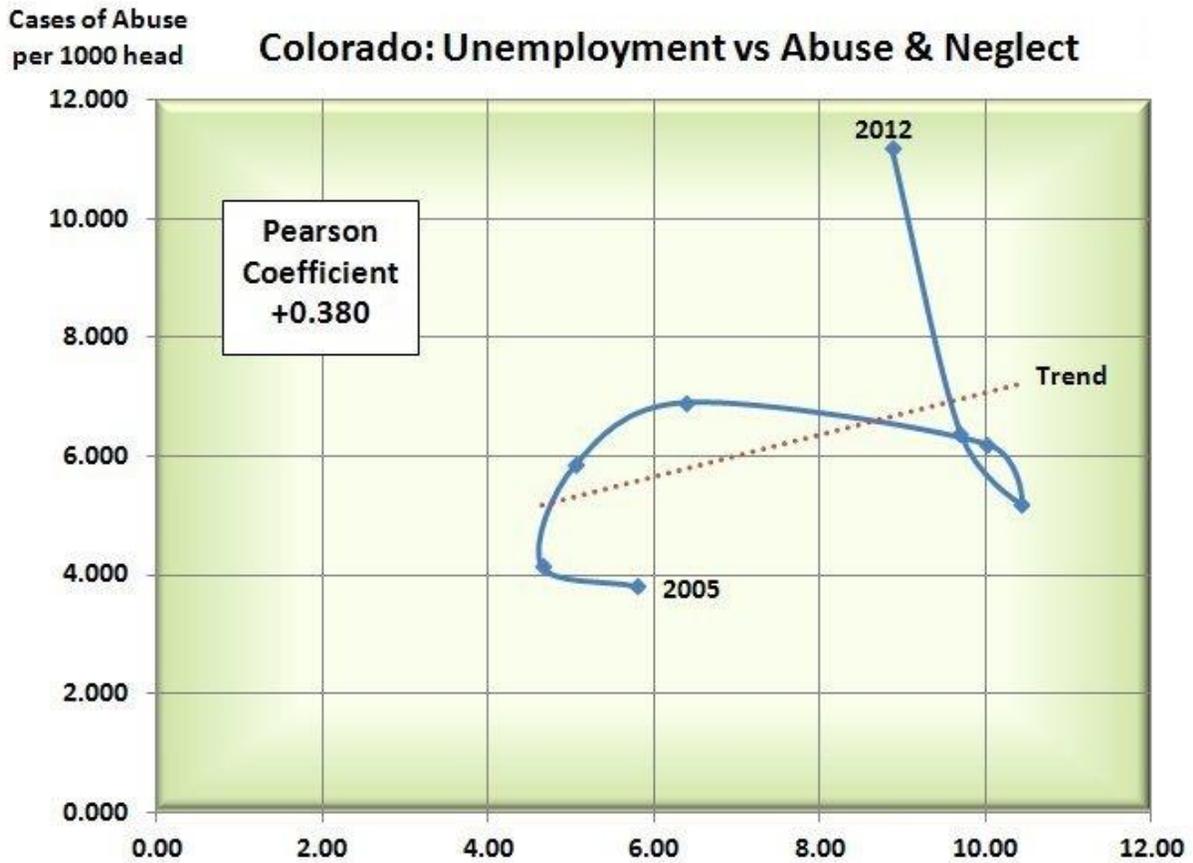
Figure 5 - Colorado Unemployment vs. Abuse and Neglect

Figure 5 shows that while other factors are clearly at work distorting the curve, there is still a measurable positive correlation between unemployment and neglect in Colorado.

The curve in Figure 6 for hay prices is a very different matter. While there is a tight loop between 2007 and 2009, the data falls largely on a straight line. The high Pearson Coefficient of .889 confirms that the influence of hay prices dominates the effect of both slaughter and unemployment.
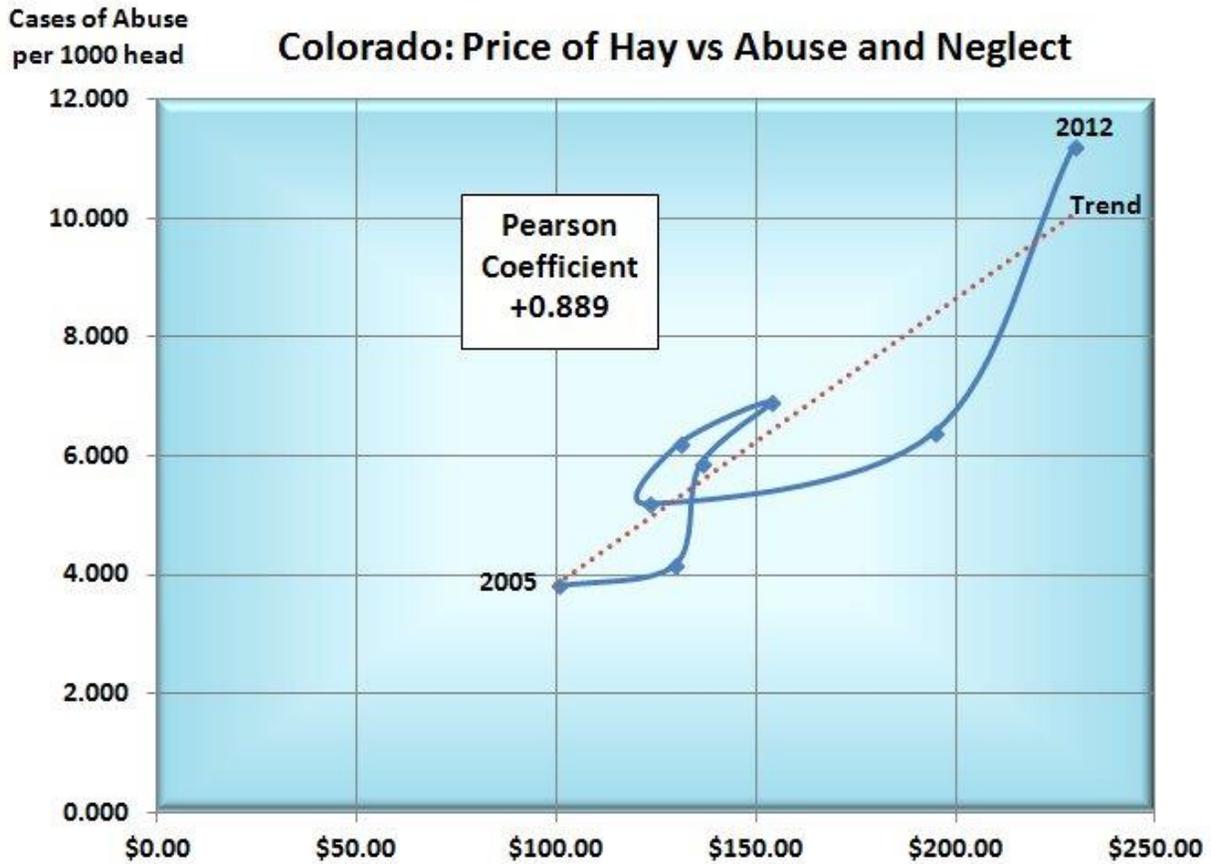

Figure 6 - Colorado Hay Prices vs. Abuse and Neglect

Georgia

Georgia offers only five years of data, so the margin of error is quite high. For example, if one took only the last five years of Illinois or Colorado, the Pearson Coefficients would be entirely different and similar to that we get for Georgia.
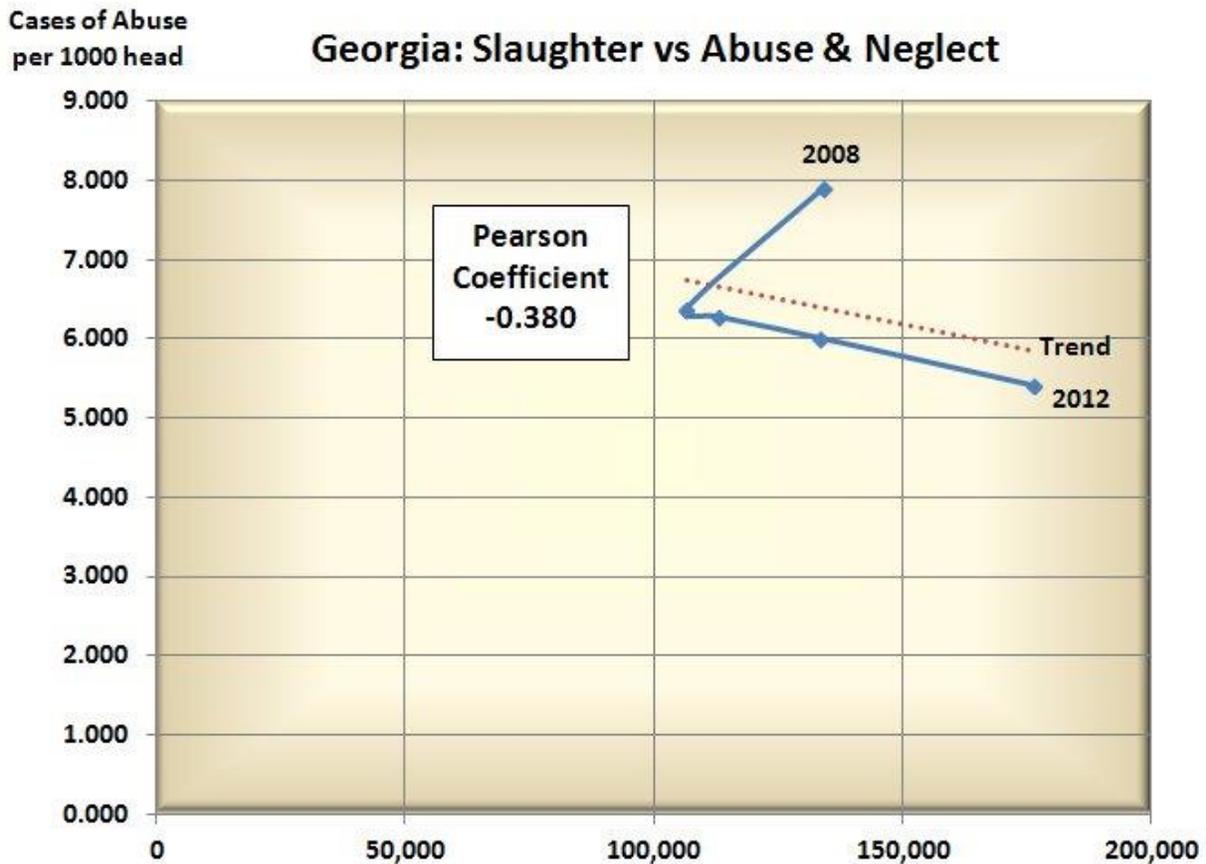

Figure 7 - Georgia Slaughter vs. Abuse and Neglect

Notice that the Pearson Coefficient for slaughter vs. abuse and neglect in Georgia is negative. This is the only case where the theory that slaughter reduces abuse and neglect appears to be supported. But if, as appears in Figure 1, the history before 2008 mirrors the other three states, then the coefficient would be positive as well. The effect of the influence of other parameters can easily swamp the relationship being graphed when only five years of data are available.
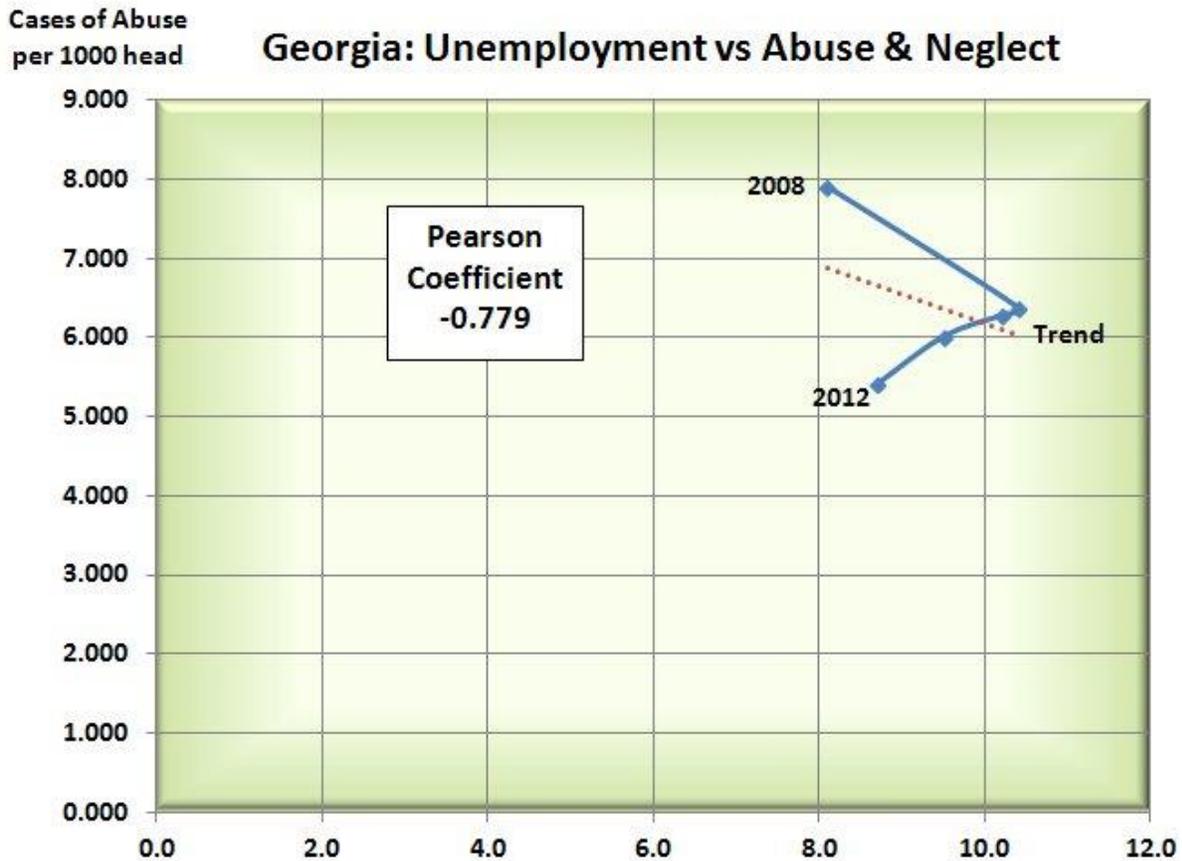
Figure 8 - Georgia Unemployment vs. Abuse and Neglect

Figure 8 shows that the influence of unemployment is also distorted by other factors. The Pearson Coefficient is moderately strong, but it indicates that a higher rate of unemployment is related to a *decrease* in abuse and neglect. Clearly this is not a valid relationship, and it is entirely due to the small data set (five years) combined with the impact of the third factor: hay prices.

The remarkable relationship between hay prices and abuse and neglect in Georgia is clearly shown in Figure 9. The result is almost a straight line, indicating that neither slaughter nor unemployment exerted significant influence on the shape of the line. The resulting Pearson Coefficient of +0.935 says it all.
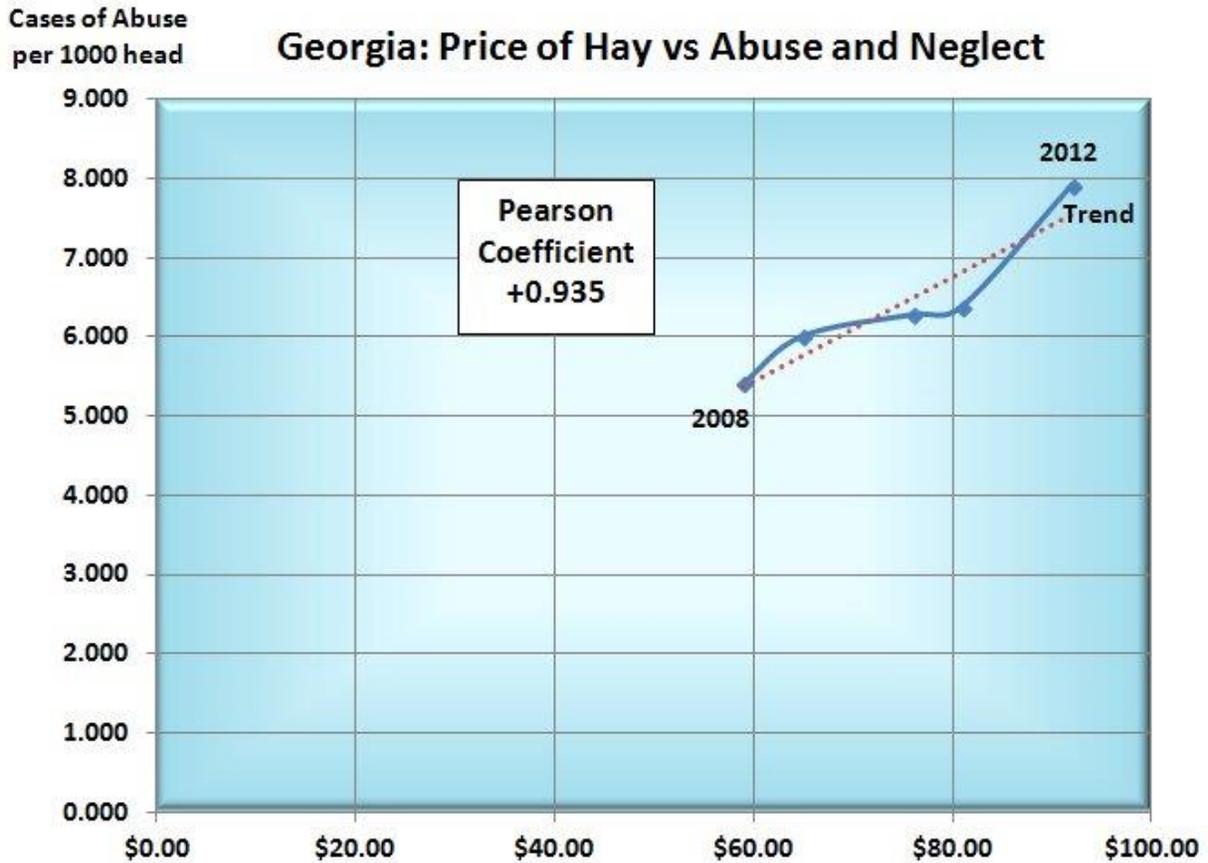
Cases of Abuse per 1000 head

Georgia: Price of Hay vs Abuse and Neglect

Pearson Coefficient +0.935

2012
Trend
2008

Figure 9 - Georgia Hay Prices vs. Abuse and Neglect

Idaho

The data set for Idaho is truncated at both ends, starting at 2002 and ending at 2011 (when responsibility was turned back over to the localities). Even so, it is a reasonable collection of data.
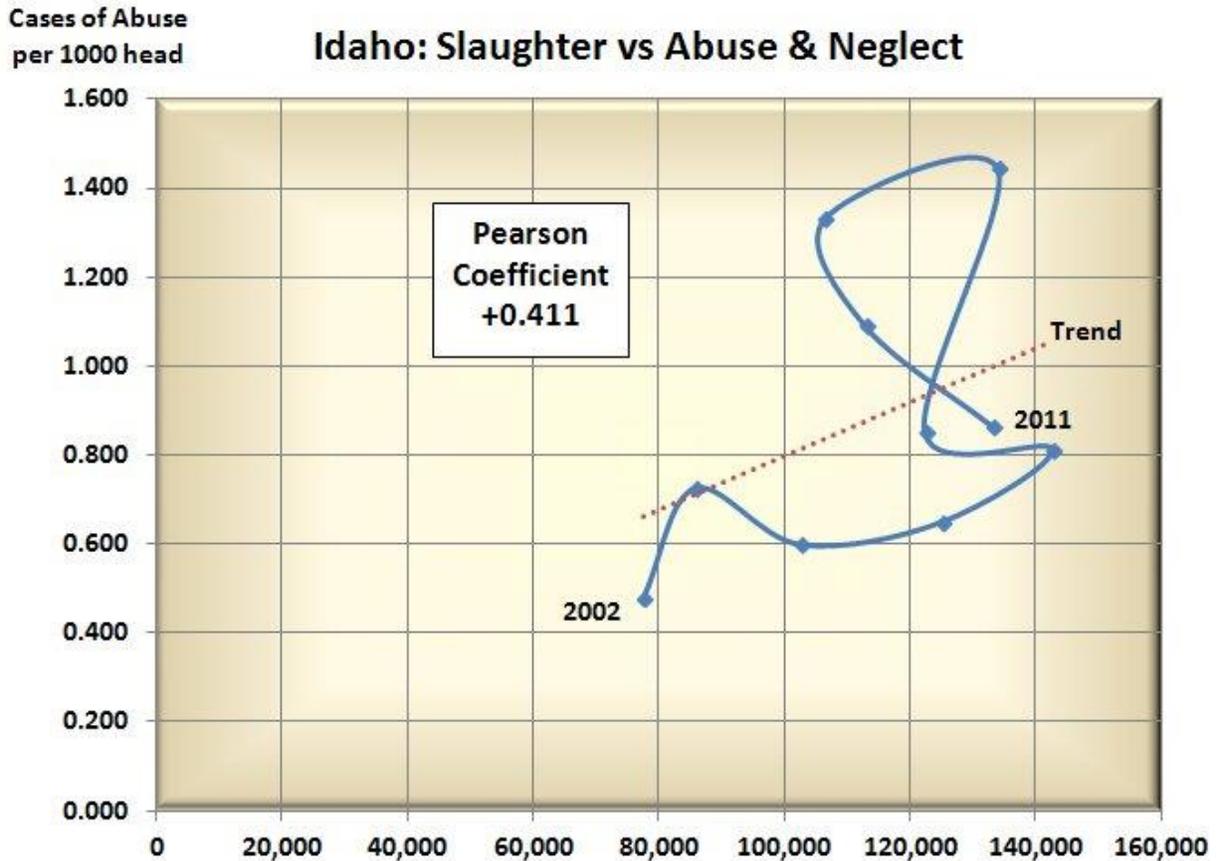

Figure 10 - Idaho Slaughter vs. Abuse and Neglect

The relationship between slaughter and abuse and neglect is again positive, with more slaughter being associated with *more* abuse and neglect. The data is clearly being distorted by one or more other functions, but the Pearson Coefficient shows a significant relationship.
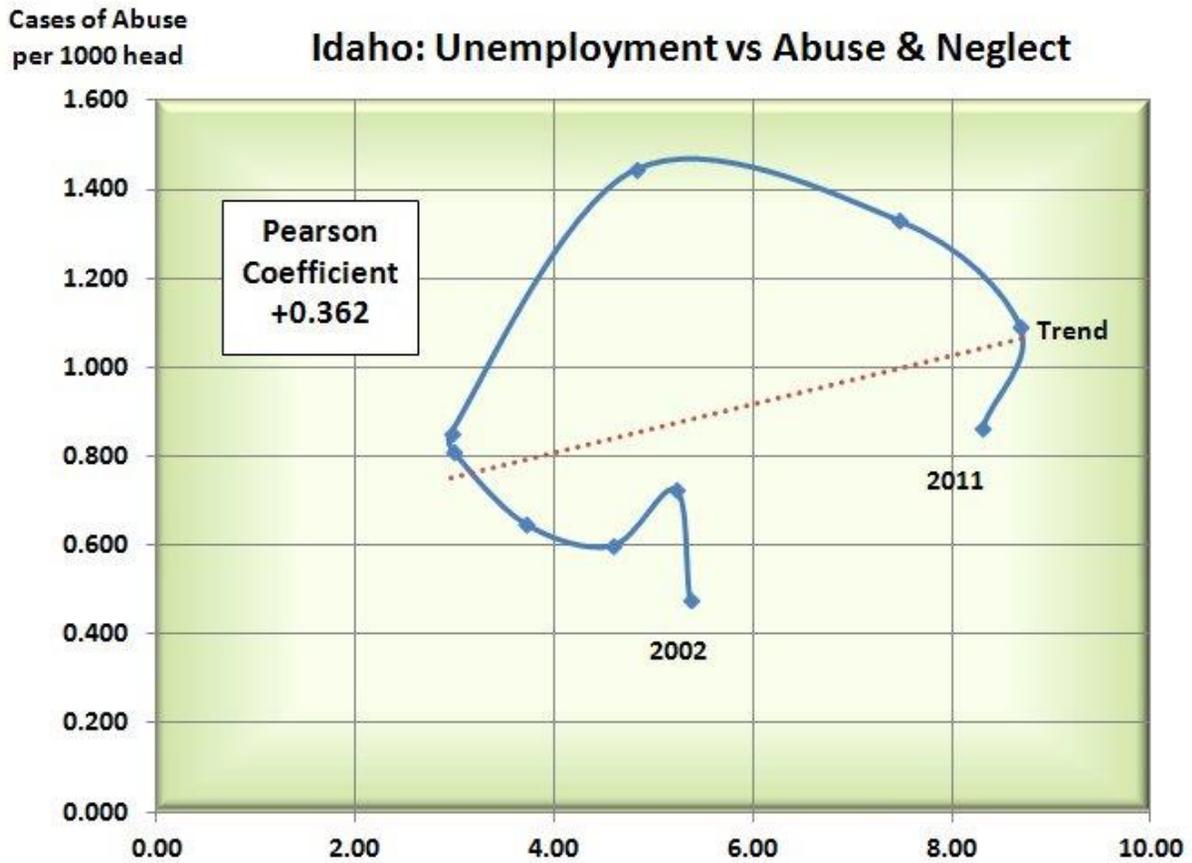
Figure 11 - Idaho Unemployment vs. Abuse and Neglect

The relationship between unemployment and neglect in Idaho (Figure 11) is clearly weak and the curve is therefore widely bulging from other influences. Figure 12 shows that while not as striking as in the previous examples, hay prices none the less dominate once again with a moderate coefficient of +0.496.

Never the less, all three factors have a positive (bad) influence on the rates of abuse and neglect.
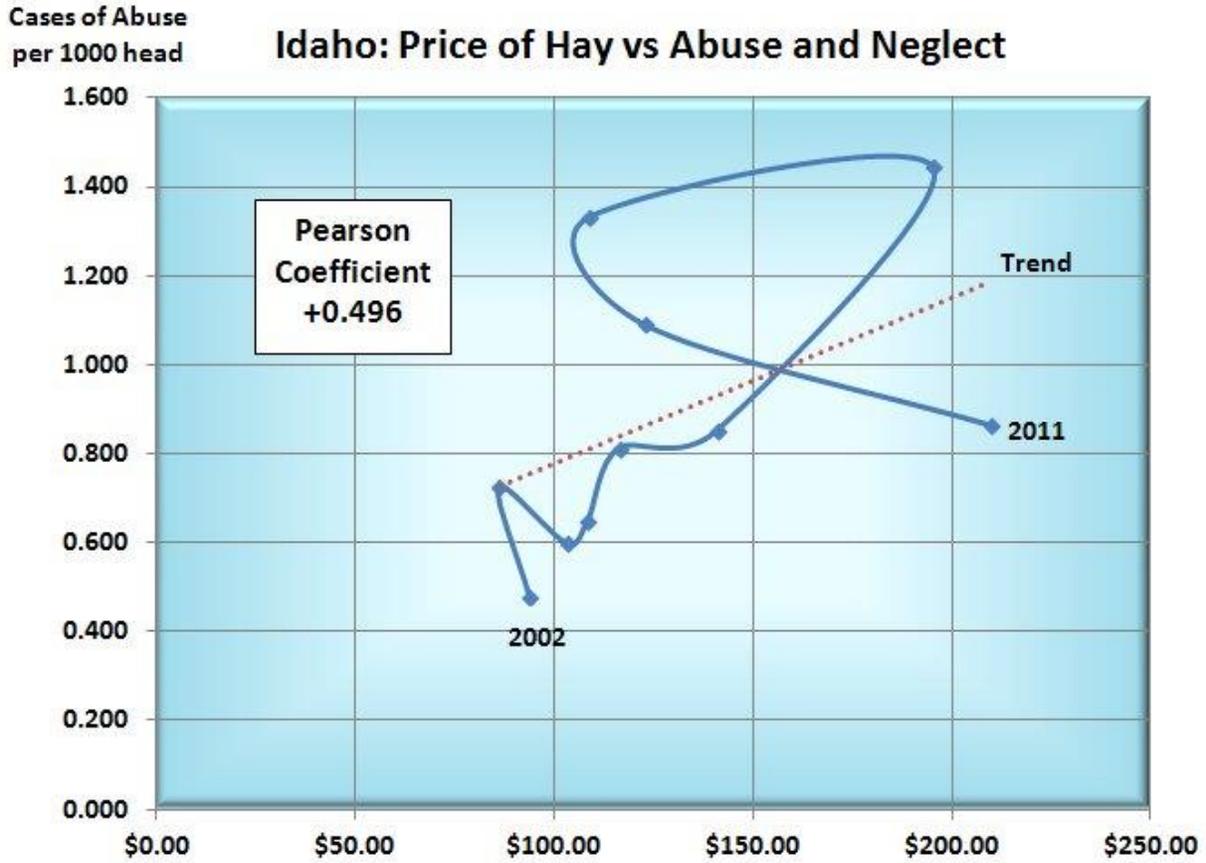

Figure 12 - Idaho Hay Prices vs. Abuse and Neglect

Illinois

Illinois has perhaps the best known history of any state. It was not only the first state to be identified as having statewide figures available; it also had Cavel, the last slaughter plant operating in the US.

Cavel burned on Easter Sunday of 2002, and was rebuilt by the summer of 2004. During this period, the plant did not operate, nor did the plant's owners or suppliers make immediate arrangements to slaughter their horses elsewhere as they did in 2007 when they were closed by a new state law.

US slaughter decreased by approximately a third from the loss of Cavel but abuse and neglect in Illinois, which had been increasing for three years, declined. The 2002-2004 period has thus been used[vii] to dispute the theory that decreasing slaughter will result in more horses being abandoned and neglected.

Figure 13 - Illinois Slaughter vs. Abuse and Neglect

Data that has become available since that period shows that the relationship, while still positive (slaughter makes abuse and neglect worse), is not as simple as a one to one relationship (Figure 13). The relatively weak Pearson coefficient shows that other forces are also at work.
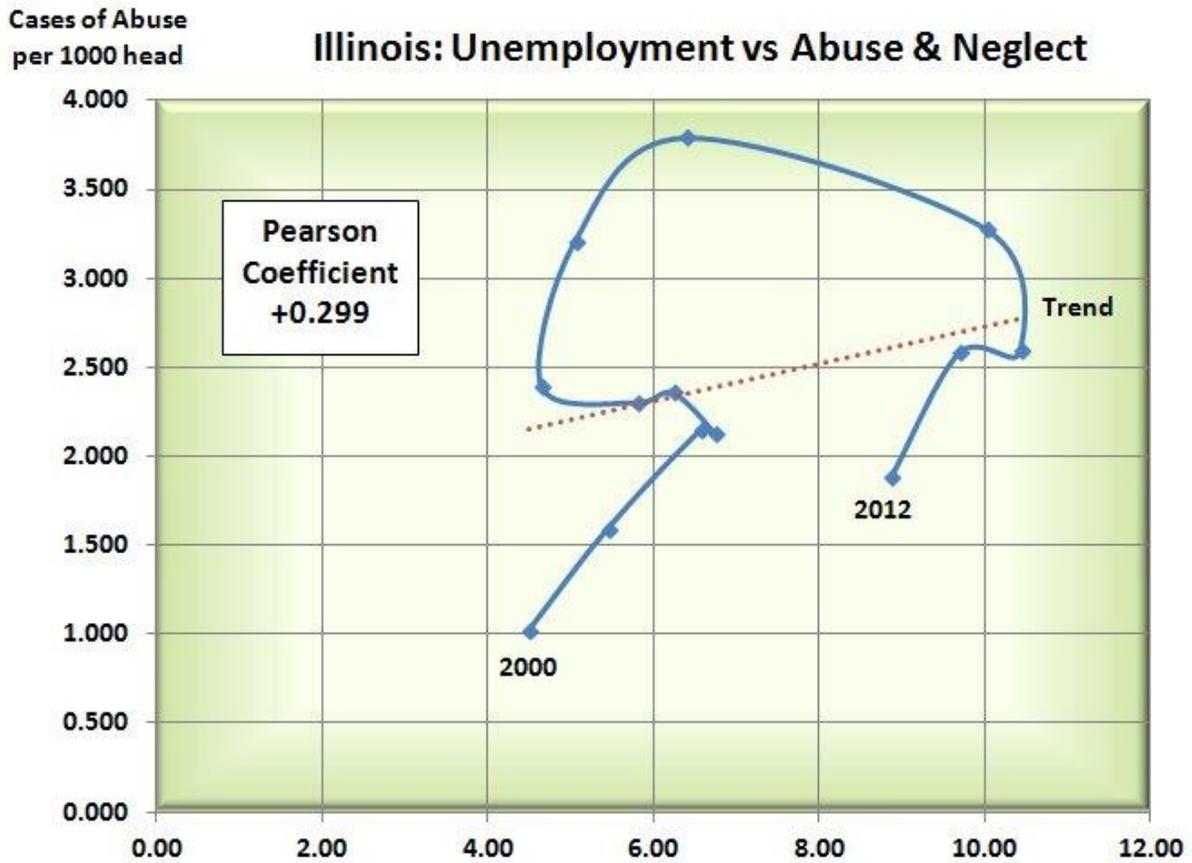
Figure 14 – Illinois Unemployment vs. Abuse and Neglect

Likewise Figure 14 shows that unemployment has a modest effect on abuse and neglect, with a Pearson Coefficient very close to that of the slaughter relationship.

The dominant factor is once again the price of hay as shown in Figure 15. The Pearson Coefficient for hay prices in Illinois is +0.529, nearly the sum of the other two factors combined.
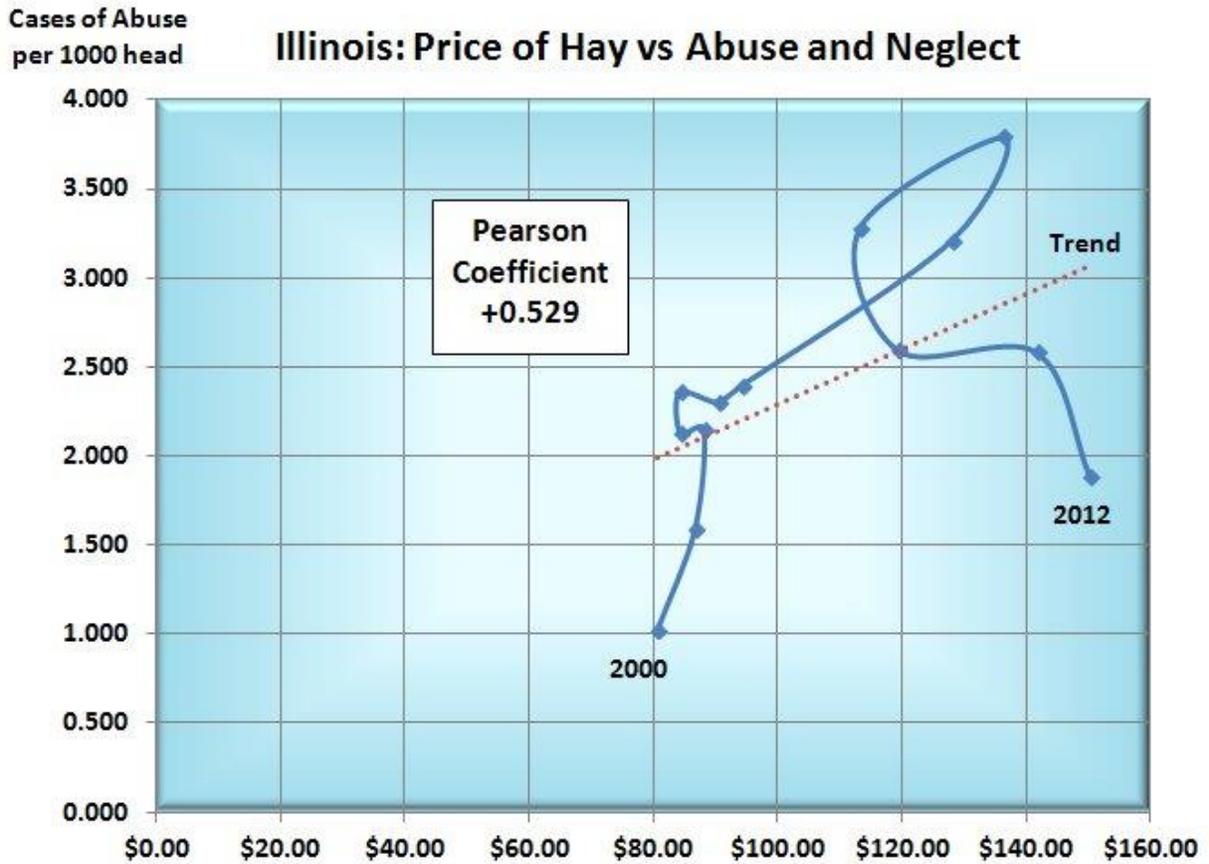
Cases of Abuse per 1000 head

Illinois: Price of Hay vs Abuse and Neglect

Pearson Coefficient +0.529

Trend

2012

2000

Figure 15 - Illinois Hay Prices vs. Abuse and Neglect

Maine

The abuse and neglect cases for Maine are amazingly similar to those for Illinois and similar in shape to all the other states (Figure 1) except for a bump in the year 2005. Maine is still keeping data, but 2012 rates had not yet been tabulated because the state only does so every two years.
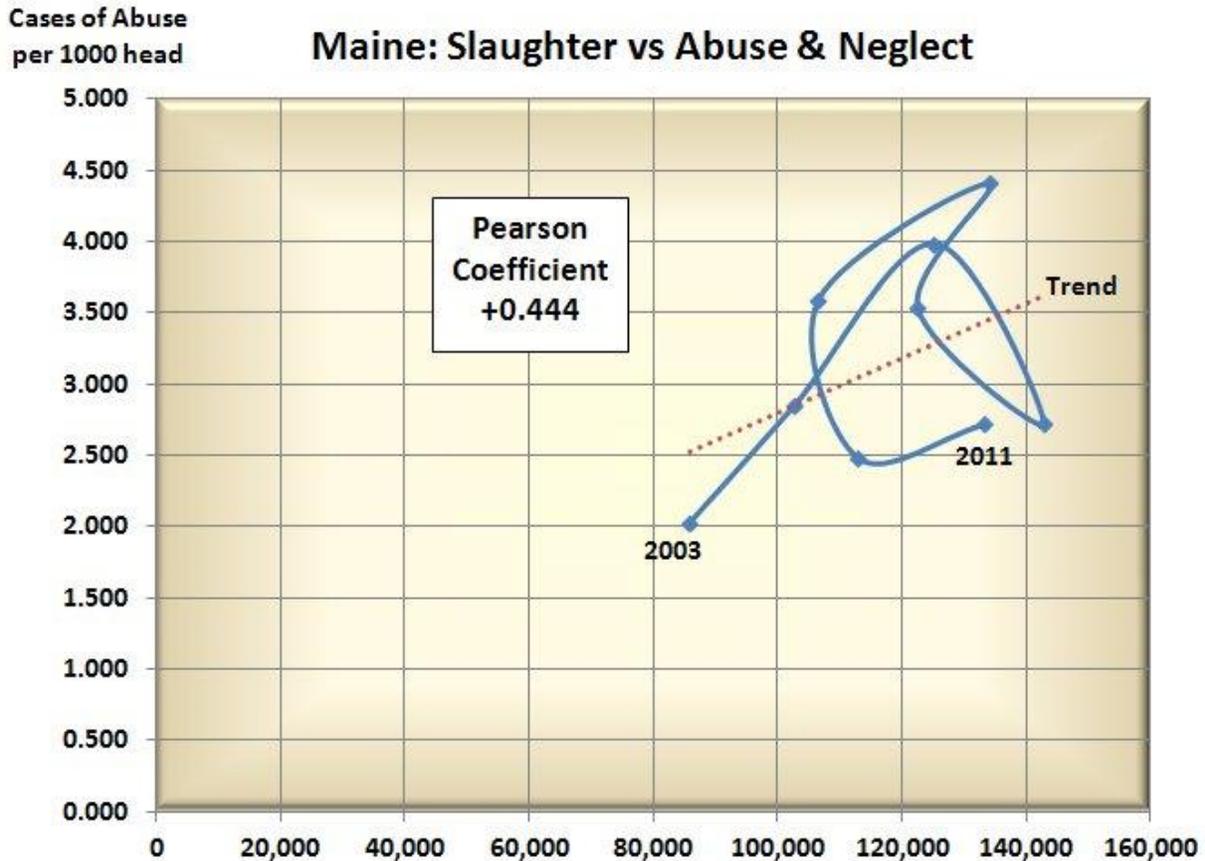
Figure 16 - Maine Slaughter vs. Abuse and Neglect

The correlation between the level of slaughter and the level of abuse is again positive for Maine at a moderate +0.444.

The Unemployment curve in Figure 17, however, shows virtually no correlation between unemployment and cases of abuse and neglect.
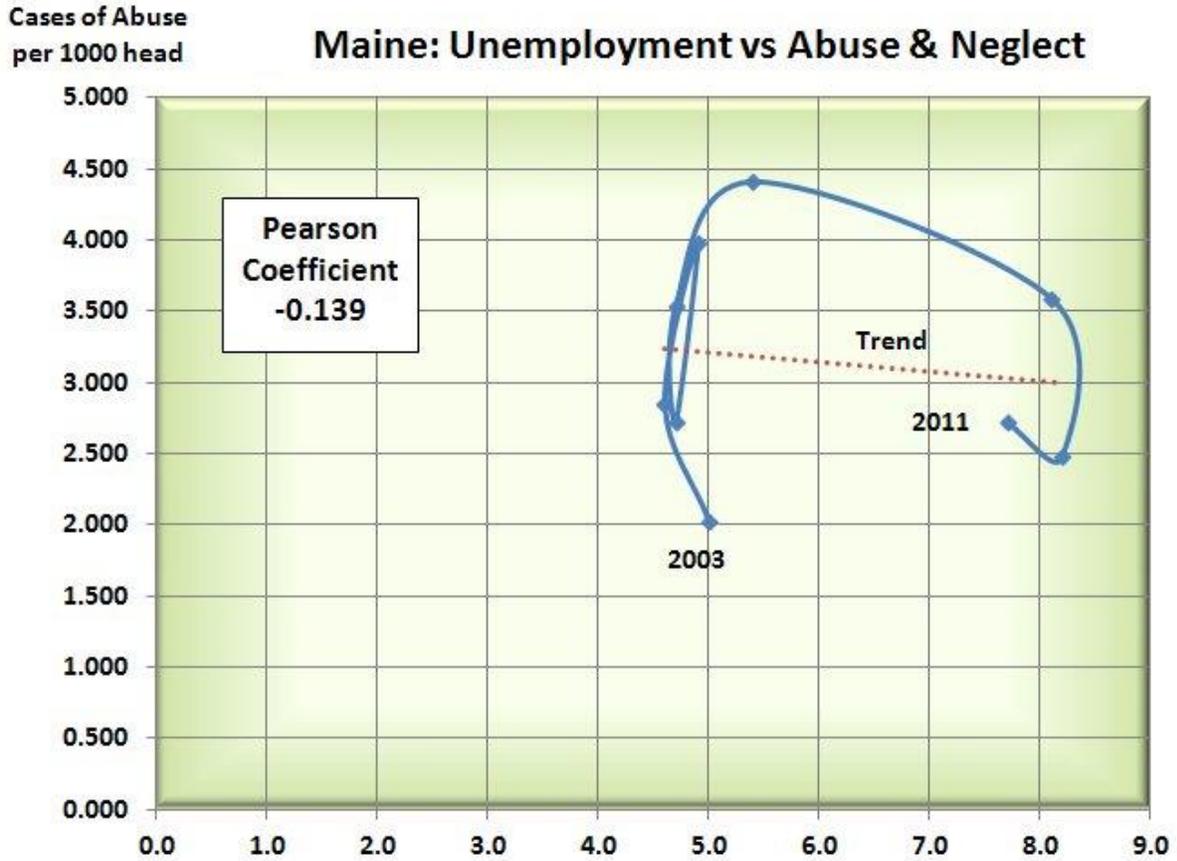

Figure 17 - Maine Unemployment vs. Abuse and Neglect

Figure 18 shows that once again the price of hay has the highest correlation to abuse and neglect rates, with slaughter running a respectable second.
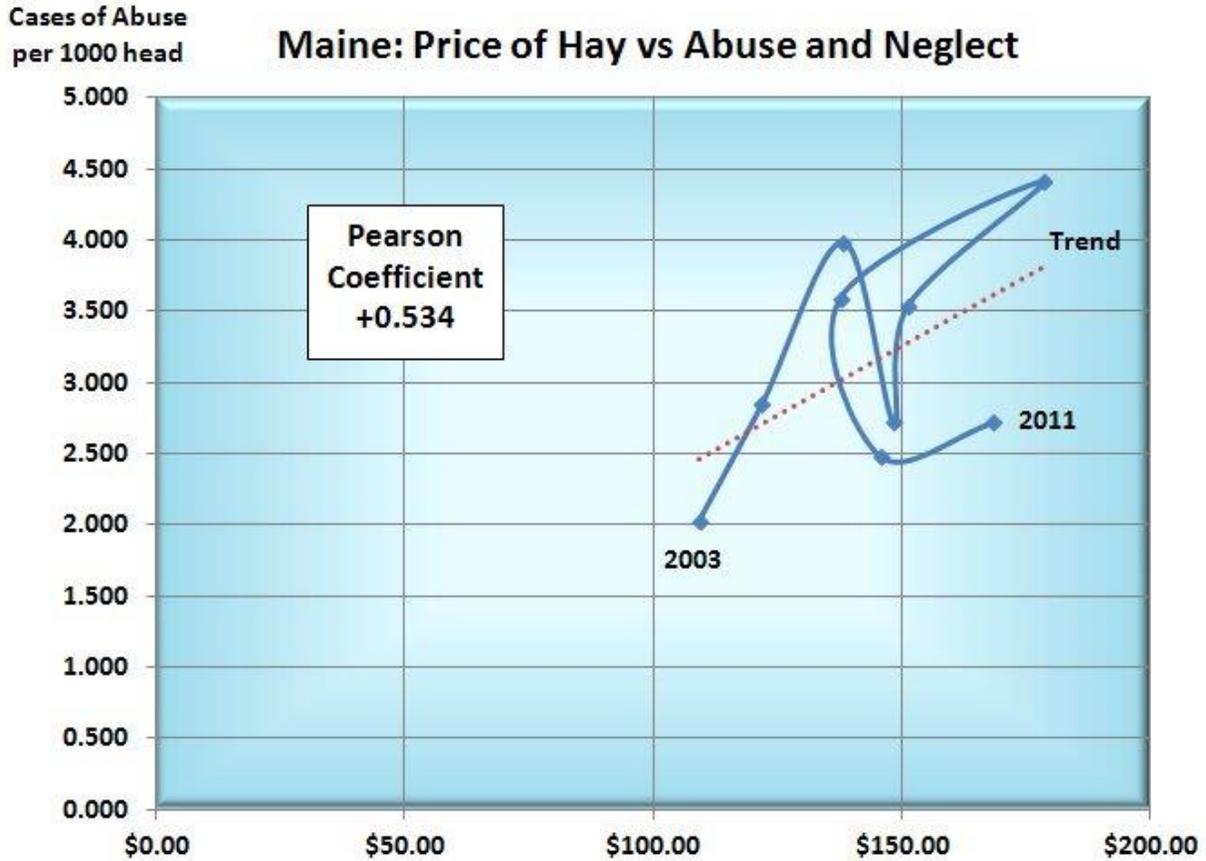
Figure 18 - Maine Hay Prices vs. Abuse and Neglect

Oregon

Oregon has a split jurisdiction over equine abuse investigations between the Oregon Humane Society and the municipalities. The data used here is from the Oregon Humane Society. The relatively low rates are due to the fact that only a fraction of the cases are being captured, but since we are looking for trends this is no problem.

Figure 19 - Oregon Slaughter vs. Abuse and Neglect

The correlation between abuse and neglect and slaughter for Oregon is the highest of any state at +0.774. Even so, it is still below the correlation with hay prices (Figure 21).
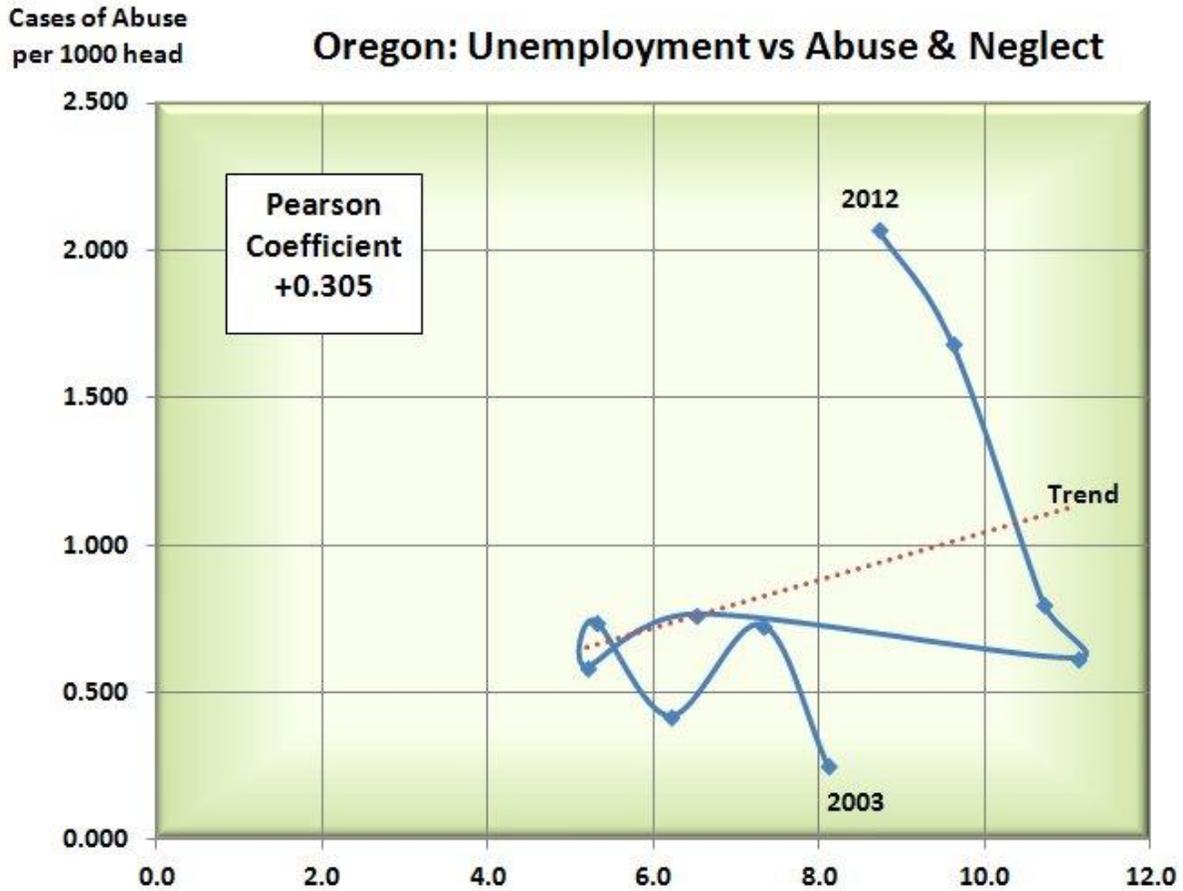
Figure 20 - Oregon Unemployment vs. Abuse and Neglect
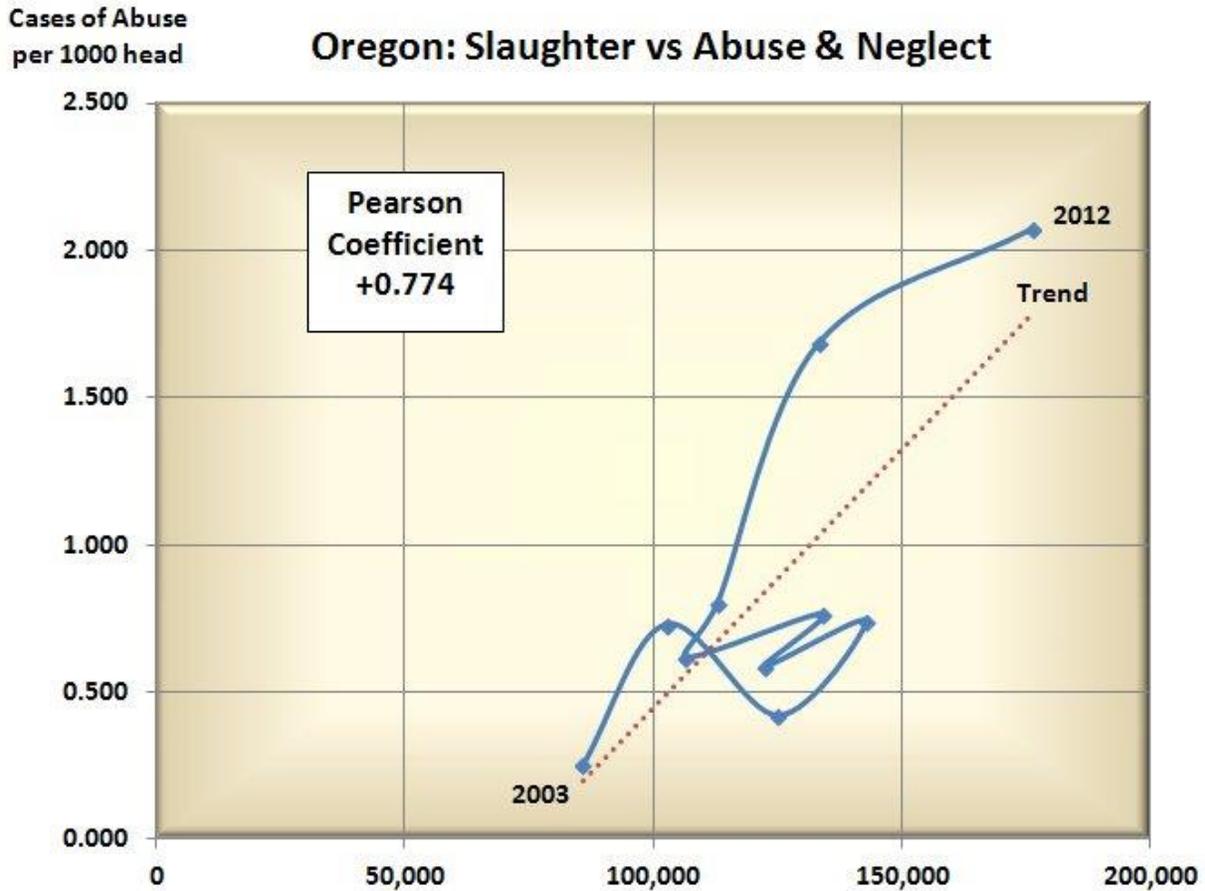
Yet again, there is only a very modest correlation between unemployment in Oregon and the rate of abuse and neglect.

Once again the price of hay is the biggest factor in determining the rate of abuse and neglect. The curve in Figure 21 shows a very clean relationship between the two, but again the relationship with slaughter is a very close second.

Cases of Abuse per 1000 head

Oregon: Price of Hay vs Abuse and Neglect

Pearson Coefficient +0.800

2012

Trend

2003

Figure 21 - Oregon Price of Hay vs. Abuse and Neglect

Conclusions

The following table summarizes the Pearson Coefficients found for each of the three factors in each state. There can be no question that the dominant factor is the price of hay. The impact of the cost of hay leads the impact of the other two factors in every state.

State	Slaughter	Unemployment	Hay Price	Data Points
Colorado	+0.698	+0.380	+0.889	8
Georgia	-0.380	-0.779	+0.935	5
Idaho	+0.411	+0.363	+0.496	10
Illinois	+0.239	+0.299	+0.529	13
Maine	+0.444	-0.139	+0.534	9
Oregon	+0.774	+0.305	+0.800	10

Slaughter and unemployment were both positively correlated to abuse and neglect for every state except Georgia (with it small data set) and Maine (where slaughter was positive but unemployment was essentially unrelated to abuse). In Colorado, Idaho, Maine and Oregon, the correlation with slaughter was greater than that of unemployment and in Illinois the two coefficients were nearly equal.

The following conclusions can thus be drawn from the currently available data:

- The most important factor by far is the cost of hay
- Slaughter is the second most important correlation to abuse and neglect
- Unemployment is the least significant contributor

The mechanism by which slaughter and abuse and neglect are linked is not as obvious as for the other two factors, and it deserves some discussion. It is important to realize that correlation is not causation. The fact that two variables correlate can mean one is dependent on the other, or that both are dependent on a third variable.

Here it should be mentioned that "abuse and neglect" are really two different offences that are lumped together. Neglect is a passive act, while abuse can be active and intentional. Thus there is the strong probability that one reason slaughter contributes to the total abuse and neglect is that the individuals involved in this business are prone to be physically abusive to their equines. There are ample examples of this.

We must, however, also consider the possibility that to some extent the rate of slaughter is driven by the price of hay, and therefore appears to correlate with abuse which we have already established to be dependent on the price of hay.

By examining a wide range of data and studies[viii ix], we know that slaughter is fed largely by young horses coming off very short careers in racing and rodeo. Very few slaughter horses come from the recreational and individual owners; with the exception of Amish work horses. Unfortunately this often means that these privately owned horses are left to fall into neglect, and we can say definitively that slaughter does nothing to prevent such neglect.

The sport horse industry is not as sensitive to hay prices as are individual horse owner because hay is a relatively smaller part of their operating budgets. However they burn through a steady stream of horses. When they present these horses for sale at low end "loose horse" or slaughter auctions there are two main classes of potential buyers: slaughter and recreational owners.

The mechanism by which hay prices might affect slaughter is therefore that with fewer recreational owners present at the auctions to support prices, more horses fall into the price range of slaughter (typically $300 or less).

In all probability both of these mechanisms are at work. One test of which of these explanations is dominant is to examine an example when causation is known. The one piece of data available to do this is the period between 2002 and 2003 when slaughter declined by approximately 30% for a known reason (the burning of Cavel). Before that period abuse and neglect had been increasing rapidly, but after the burning the rate actually declined. Moreover, the price of hay was remarkably stable in Illinois over that period as was the rate of unemployment.

One can conclude, therefore, from all available data, that slaughter is in fact a positive contributor to the rate of abuse and neglect to at least some extent, and that in no case is it shown to reduce abuse and neglect.

Likewise, unemployment can place horse owners in a position where they are unable to afford the costs of properly keeping their horses. Thus unemployment most probably contributes to the "neglect" side of the abuse and neglect cases.

There is some good news in this, and that is two of the three contributors to abuse and neglect are to some extent controllable through government policies. The subsidizing of ethanol in gasoline, high sugar cane tariffs and high gas prices lead to a massive increase in corn prices starting in 2006[x]. This in turn caused a huge change in land use away from hay and alfalfa production and to corn production, reducing the supply of hay (Figure 15) and increasing its cost.
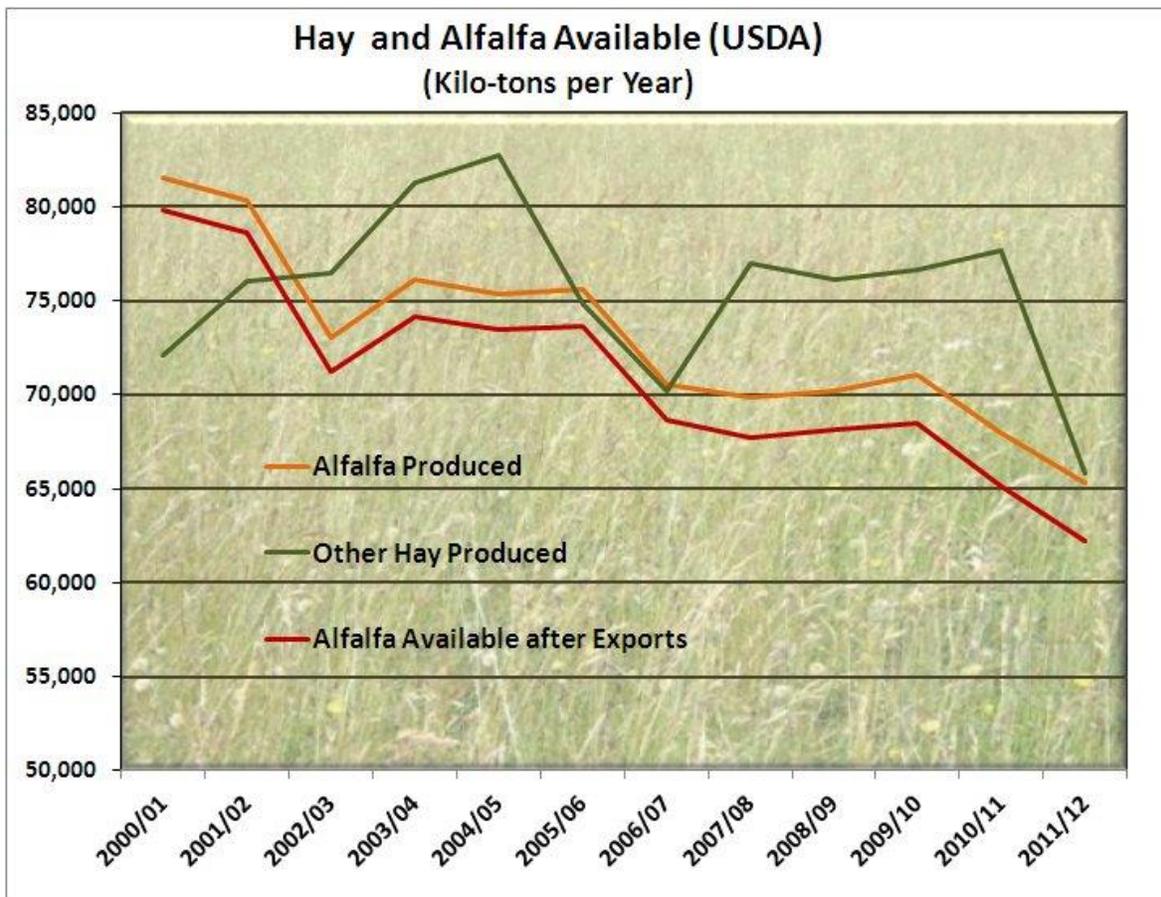
Figure 22 - Hay and Alfalfa Available in the US

When this constriction of the hay and alfalfa crop was combined with government promoted export of these commodities, the amount of available hay declined precipitously (Figure 22). As droughts then occurred from the Southeast to the Western states, they had a devastating effect on the already struggling horse owners.

The spike in abuse and neglect in 2008 was undoubtedly the result of the spike in hay prices across much of the country (Figure 2) due to the massive 2007-2008 drought in the Southeastern US. The GAO report did not even mention this event or the resulting hay prices, instead blaming the increased abuse and neglect on shift of slaughter to Canada and Mexico after the closing of the US plants, and the resulting longer hauling distances.

Both the subsidy of ethanol in gasoline and the tariff on sugar cane for ethanol were removed by Congress in 2012. Hopefully this will result in more land allocation to hay and alfalfa.

Finally, Congress can easily halt the slaughter of US horses. Bills (HR.1049 and S.541) are presently are presently before Congress that would accomplish this.

Hopefully, the true effect of slaughter shown in this study will help members in making this decision.

According to the American Horse Council study of 2005, the horse industry in the US was estimated to generate $39 Billion in direct revenues and $102 billion in indirect revenues. This impact to the economy alone should be reason enough to take make an effort to understand and mitigate the factors eroding horse welfare and ownership.

Appendix I – Source code for Pearson Coefficient Calculator

```vb
Private Sub CmdCalculate_Click(ByVal sender As System.Object, ByVal e As
        System.EventArgs) Handles CmdCalculate.Click

        Dim i As Integer      'Pointer index
        Dim n As Integer      'Number of points
        Dim X As Double
        Dim Y As Double
        Dim SumX As Double = 0
        Dim SumY As Double = 0

        Dim SumXY As Double = 0
        Dim SumXsq As Double = 0
        Dim SumYsq As Double = 0
        Dim r As Double 'Pearson coefficient

        n = DataGridView1.Rows.Count - 1

        For i = 0 To n - 1
            X = DataGridView1(1, i).Value
            Y = DataGridView1(2, i).Value

            SumX = SumX + X
            SumY = SumY + Y
            SumXY = SumXY + (X * Y)

            SumXsq = SumXsq + (X ^ 2)
            SumYsq = SumYsq + (Y ^ 2)

        Next

        r = ((n * SumXY) - (SumX * SumY)) / Math.Sqrt(((n * SumXsq)
        - (SumX ^ 2)) * ((n * SumYsq) - (SumY ^ 2)))

        LblR.Text = Format(r, "0.000")


End Sub
```

[i] Government Accountability Office (GAO) 2011, *HORSE WELFARE Action Needed to Address Unintended Consequences from Cessation of Domestic Slaughter, GAO-11-228*

[ii] American Horse Council Foundation (AHCF). 2005, *The economic impact of the horse industry on the United States*. Washington, D.C.: AHCF.

[iii] United States Dept. of Labor (USDL), Bureau of Labor Statistics (BLS), http://data.bls.gov

[iv] US Dept. of Agriculture (USDA), National Agricultural Statistics Service (NASS), http://www.nass.usda.gov/Quick_Stats/Lite/

[v] US Dept. of Agriculture (USDA) on line reports

Weekly Domestic Slaughter, http://www.ams.usda.gov/mnreports/sj_ls711.txt

Weekly Exports to Mexico, http://www.ams.usda.gov/mnreports/al_ls635.txt

Foreign Agricultural Service (USDA/FAS) Weekly Exports to Canada and Japan, http://www.fas.usda.gov/ustrade/USTExFatus.asp?QI=

[vi] University of California San Diego (UCSD), The Correlation Coefficient (Pearson's r), http://weber.ucsd.edu/~aronatas/corr.html

[vii] Animal Law Coalition (ALC), A Study of Equine Slaughter/ Abuse Patterns Following Closure of Horse Slaughter Plants in US; Jacobson, Holland, Charlton, http://animallawcoalition.com/a-study-of-equine-slaughter-abuse-patterns-following-closure-of-horse-slaughter-plants-in-us/

[viii] Colorado State University, Survey of Trucking Practices and Injury to Slaughter Horses, Dr. Temple Grandin

[ix] Victoria McCullough, Veterinary evaluation of 394 horses purchased at a slaughter auction over two days in 2007 (every equine at sale).

[x] Kentucky Journal of Equine, Agricultural and Natural Resources Law (Vol 5. No.2), John Holland, Laura Allen, *An Analysis of Factors Responsible for the Decline of the U.S. Horse Industry: Why Horse Slaughter is not the solution.*