Weldon Bosworth
Gilford, NH 03249

March 19, 2020

Mr. Paul Sanderson
Mr. Glenn Normandeau, Executive Director, New Hampshire Fish and Game
New Hampshire Fish and Game Commissioners

RE: Written Comments to F&G Commission - Biennial Game Management Hearing March 30, 2020

Dear Sirs:

My name is Weldon Bosworth. I live in Gilford, NH. As an environmental consultant for over 45 years I have evaluated a variety of potential impacts to populations and communities of biological organisms using quantitative methods. I have a Ph.D. in ecology.

During the initial Biennial Hearing held on December 11, 2019, I submitted testimony which included an analysis of the declining fisher, red fox and gray fox populations. NH Fish and Game elected to ignore my conclusions and make no changes to the seasons or bag limits of these species in their proposal for the next biennium. Although the Commission claims their decisions are guided by science, in my opinion the decision not to close the season for fisher and at least decrease the bag limits for the fox species contradicts that claim.

I am puzzled by the fact that although I spent a substantial amount of time in conducting the analysis that I submitted last December, none of the Fish and Game biologists responsible for the recommendations on seasons and bag limits responded to what I believed were conclusions supported by science. Although I realize there is no provision for responding to comments, it would certainly be nice to understand the rationale, if there is one, that supports no change in the seasons and bag limits of these species. While the public would hope that wildlife management decisions are made based upon sound science, we witness, instead, that there is no objective science offered from either the staff or the Commission to support rule making for furbearers. I believe NH Fish and Game should spend at least as much time in analyzing trends in furbearer populations as I have here. Instead, we hear unsupported speculation that these species are just in the trough of some cycle, opinions that some source of mortality other than hunting or trapping is responsible for the decline in Catch per Unit Effort, or that NH Fish and Game's own data is erroneous because anecdotal observations say otherwise. This is not science. Why can't NH Fish and Game the department apply the same kind of objective analytical tools they do to manage the whitetail deer, moose bear, turkey and moose populations.

So I will try once again with the attached analysis, expanded from my December testimony, to convince you, New Hampshire's wildlife resource trustees and scientists, that there is no credible rationale for ignoring the obvious decline in the populations of the fisher, red fox and gray fox.

I would welcome an opportunity to discuss these data and results in a forum of NH Fish and Game biologists and representatives from the trapping community.

Sincerely,

W S Bosworth

Weldon Bosworth, Ph.D.,
Gilford, NH
wbosworth@outlook.com

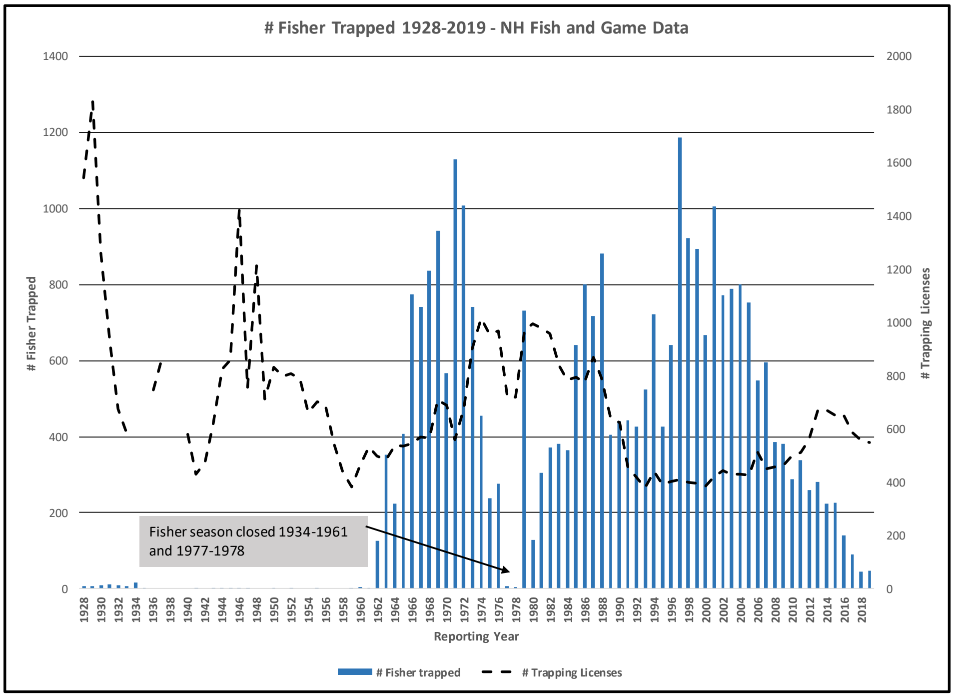
Executive Summary: The Case for Closing the Fisher Season

This analysis of the fisher population presents evidence that supports a decision that the season for fisher should be closed. This evidence includes:

1) A significant decline in the number of fishers trapped over the last 30 years;
2) A significant decline in fisher CPUE over the last 30 years;
3) A statistical comparison of CPUE from 2005-2019 to CPUE from 1990-2004 which indicates that the CPUE for the most recent 15 years significantly ("highly significant") lower than the 15 years from 1990-2004;
4) Based upon a statistical comparison, the CPUE from 2005 through the present has been statistically the same: and
5) A statistical comparison that documents that the fisher harvest since 2008 has been significantly below the lower 95% confidence limit of the mean harvest (a proposed surrogate for a sustainable population) over the last 30 years.

As part of this analysis, the relevance of what was termed an "uptick" in fisher CPUE in 2019 at a previous Commission hearing is put into statistical perspective. Additionally, a cautionary note on how failure to act now by closing the fisher season is one step further along a path where the negative consequences of making wildlife management decisions within the context of a shifting baseline become a reality.

They say a picture is worth a thousand words. I believe the following chart tells the story of the failure to manage a healthy, sustainable population of fisher as required by statute.



This chart of fisher harvest (total number trapped) from 1928 to the present reveals substantial variability which appears to have an inverse relationship to the number of trapping licenses. More importantly, these data show that the number of fishers were so low during two periods that the trapping season had to be closed. The fisher season was closed from 1934 until 1961. As the fisher population rebounded, the season was opened in 1961 and remained open until 1977 when it was closed again for two years.

Numerous examples of how management of fishery and wildlife resources without considering a “shifting baseline” has led to population instability and crashes. In fact, this appears to have happened with the fisher population in the late 70’s (See above figure). Ignoring the obvious trend of a declining fisher population, even more trapping licenses were sold during the late 70’s and the fisher population once again declined to a point where the season had to be closed. While current wildlife governance cannot be held responsible what happened 40 plus years ago, unfortunately this pattern appears to be repeating itself today and very little is being done about it. This outcome is not only a consequence to the fisher population, it also has ramifications to the entire ecosystem of which the fisher is a key component.

In the absence of any knowledge on what constituted a sustainable population of fisher, in the attached analysis I have assumed that the average harvest over the last 30 years would be a reasonable surrogate for a sustainable population. Based upon this assumption the most recent fisher harvest of 48 animals is <u>88% fewer animals</u> than the lower 95% confidence limits of the mean harvest over the last 30 years. Based upon the trend in fisher CPUE and harvest data analyzed here it is apparent that the fisher population cannot support continued trapping pressure and be sustainable.

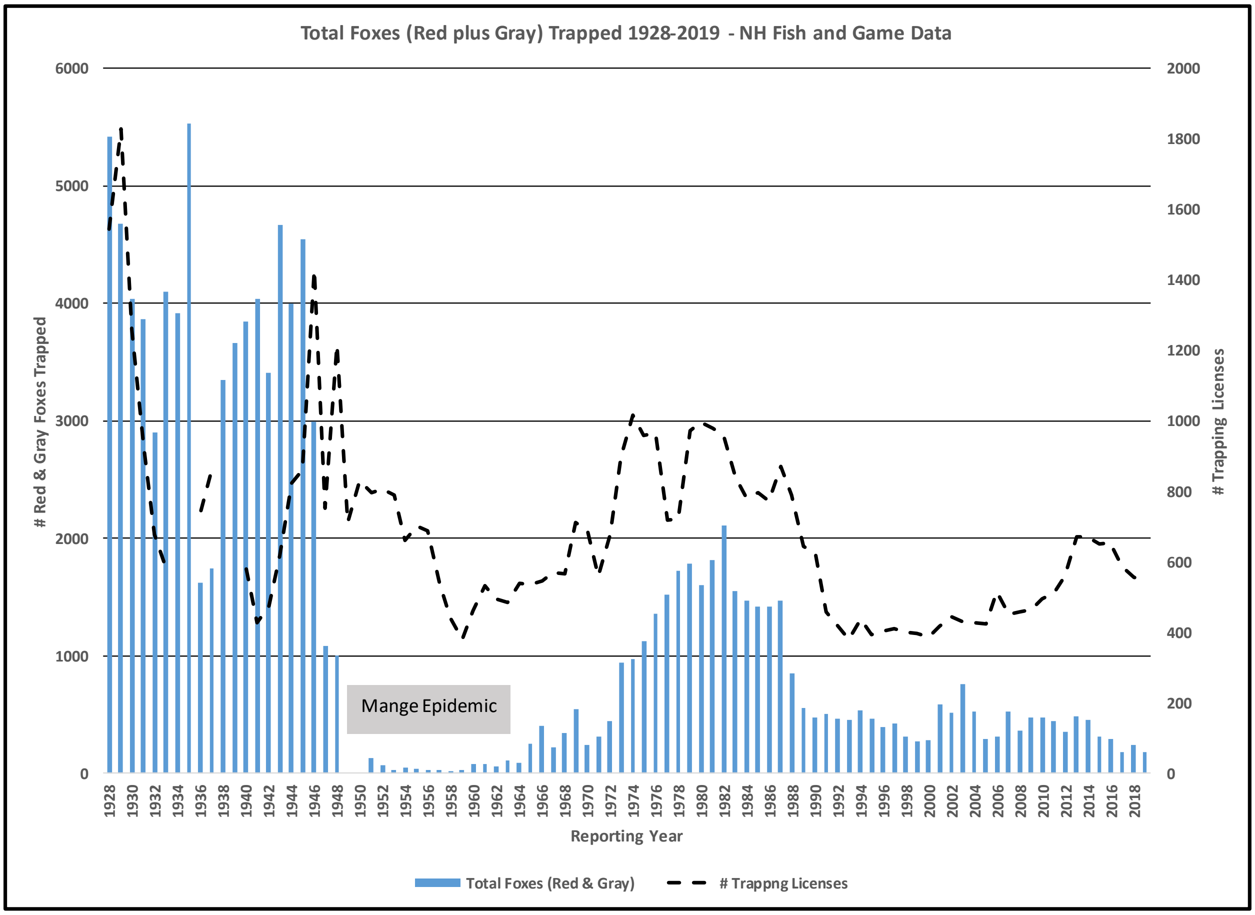
While there may be other uncontrolled variables, e.g., disease, weather, roadkill etc., that may help explain the apparent decline in the fisher population, <u>trapping and hunting pressure are the only sources of mortality over which the Commission has some control, i.e. by closing seasons or adjusting bag limits</u>. Using these management tools, in fact, is the primary means by which the Commission can fulfil its statutory responsibility of assuring a healthy, sustainable population of wildlife species. The Commission is well acquainted with the concept of adjusting seasons or bag limits to respond to changes in the abundance of other game species; whitetail deer, bear and wild turkey have been successfully managed to maintain a reasonably sustainable harvest over many years. Now is the time to apply these same principles to furbearers like the fisher.

The Case for Decreasing Bag Limits of Red and Gray Fox

This analysis of the fox species presents evidence that supports a decision for decreasing bag limits for both the red and gray foxes. This evidence includes:

1) A significant decline in the number of red and gray fox trapped over the last 30 years;
2) A significant decline in red and gray fox CPUE over the last 30 years;
3) A statistical comparison of Catch per Unit Effort (CPUE) over the last 30 years based upon five-year intervals which indicates that the CPUE for most recent 15 years is significantly lower than the 15 years from 1990-2004 for red fox and significantly lower for several of those five-year periods for the gray fox; and
4) A statistical comparison that documents that the red fox harvest has been significantly below the lower 95% confidence limit of the mean harvest (a proposed surrogate for a sustainable population) since 2014 and the gray fox harvest has been below the lower 95% confidence limit of the mean since 2016.

The following chart tells the story of the failure to manage a sustainable, healthy population of foxes as required by statute.



The red fox and gray fox harvest[1] (total number trapped) from 1928 to the present revealed substantial variability (above figure). After the fox populations recovered from a mange epidemic in the southern part of the state in the 1950's the increase in trapping pressure (judging from the increase in trapping licenses: from a low of around 400 to about 1000) resulted in a decline in number of foxes of both species harvested by the late 1980's.

These data also show that the number of foxes (of both species) harvested has declined dramatically since the early 1980's, from a total of over 2100 in 1982 to only 164 last year, a decrease of over 92%. It appears from these data the declines in harvest follow an increase in trapping pressure as reflected in the number of trapping licenses issued.

Trend analysis of CPUE indicates that the estimated decline in the populations of both species of fox was about 50% (red fox=49%; gray fox=60%) in the last 30 years based upon a linear model. The number of both species of fox trapped over the last few years has also been significantly below the 95% confidence interval of the mean for the last 30 years.

While there may be other uncontrolled variables, e.g., disease, weather, roadkill etc., that may help explain the apparent decline in these fox populations, trapping and hunting pressure are the only sources of mortality over which the Commission has some control, i.e. by closing seasons or adjusting bag limits. Using these management tools, in fact, is the primary means by which the Commission can fulfil its statutory responsibility of assuring a healthy, sustainable population of wildlife species. The Commission is well acquainted with the concept of adjusting seasons or bag limits to respond to changes in the abundance of other game species; whitetail deer, bear and wild turkey have been successfully managed to maintain a reasonably sustainable harvest over many years. Now is the time to apply these same principles to furbearers like the red and gray fox.

Although data on the red and gray foxes suggests that while their population may not yet be at a point where closure of their season is required, the steady decline in CPUE and numbers harvested urges caution in any management decisions relating to season or bag limits. As discussed in the following analysis, using the last two years' CPUE data as evidence of a reversal in a long-term decline in their population is not supported. In fact, the CPUE data for neither the red fox nor the gray fox over these last 15 years are significantly different. In my opinion a prudent wildlife manager would decrease the red fox and gray fox bag limit to three per season, statewide, as was proposed in the last biennium. It was the appropriate decision then and nothing has changed in the two years since then that would support a less conservative decision. An objective person only must look at the combined harvest data for both the red and gray fox (above figure) to understand that their populations are not being managed sustainably as required by statute.

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[1] Red fox and gray fox have been combined in this chart as the species were not differentiated in trapping results until 1971.

The Case for Closing the Fisher Season

Weldon Bosworth, Ph.D.
March 30, 2020

This paper presents evidence supporting a decision that the season for fisher should be closed. This evidence includes:

1) A significant decline in the number of fishers trapped over the last 30 years;
2) A significant decline in fisher Catch per Unit Effort (CPUE)[1] over the last 30 years;
3) A statistical comparison of CPUE from 2005-2019 to CPUE from 1990-2004 which indicates that the CPUE for the most recent 15 years significantly ("highly significant") lower than the 15 years from 1990-2004;
4) Based upon a statistical comparison, the CPUE from 2005 through the present has been statistically the same: and
5) A statistical comparison that documents that the fisher harvest since 2008 has been significantly below the lower 95% confidence limit of the mean harvest over the last 30 years.

As part of this analysis, the relevance of what was termed an "uptick" in CPUE in 2019 at a previous Commission hearing is put into statistical perspective. Additionally, a cautionary note on how failure to act now by closing the fisher season is one step further along a path where the negative consequences of making wildlife management decisions within the context of a shifting baseline become a reality.

Introduction

Changes in fisher CPUE and harvest data for the last 30 years, 1990-2019, were evaluated using trend analysis and hypothesis testing. The CPUE data were taken directly from the Annual Harvest Summaries on the NH Fish and Game website https://www.wildlife.state.nh.us/hunting/harvest-summary.html.

CPUE is an indirect measure of the abundance of a target species. Variation in CPUE is inferred to reflect changes to the target species' true abundance. CPUE has several advantages over other methods of measuring abundance, e.g., observation transects, trail cameras or aerial counts. The data are relatively easy to collect and analyze, even for non-scientists. One major advantage of using CPUE to infer population abundance is that the sources or magnitude of other variables that affect mortality, e.g., disease, interspecific competition, roadkill, etc., do not have to be known or quantified. Provided the unit of effort is standardized, in this case catch per 100 trap nights, the relationship between the CPUE and the inferred population abundance remains constant and comparison of inferred population size over time or among areas being managed can be made. CPUE is widely used throughout the world to monitor and manage both wildlife and fish populations.

Changes in fisher harvest and CPUE over the last 30 years were also compared statistically to ascertain whether, even within the context of annual natural variability, CPUE in recent years is representative of a sustainable population.

Lastly, total number of fishers trapped per year from 1928 through 2019 were examined to see whether there was any pattern that could be instructive in making management decisions for the fisher population today.

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[1] Catch per Unit Effort is equivalent to number of animals trapped per 100 trap nights.

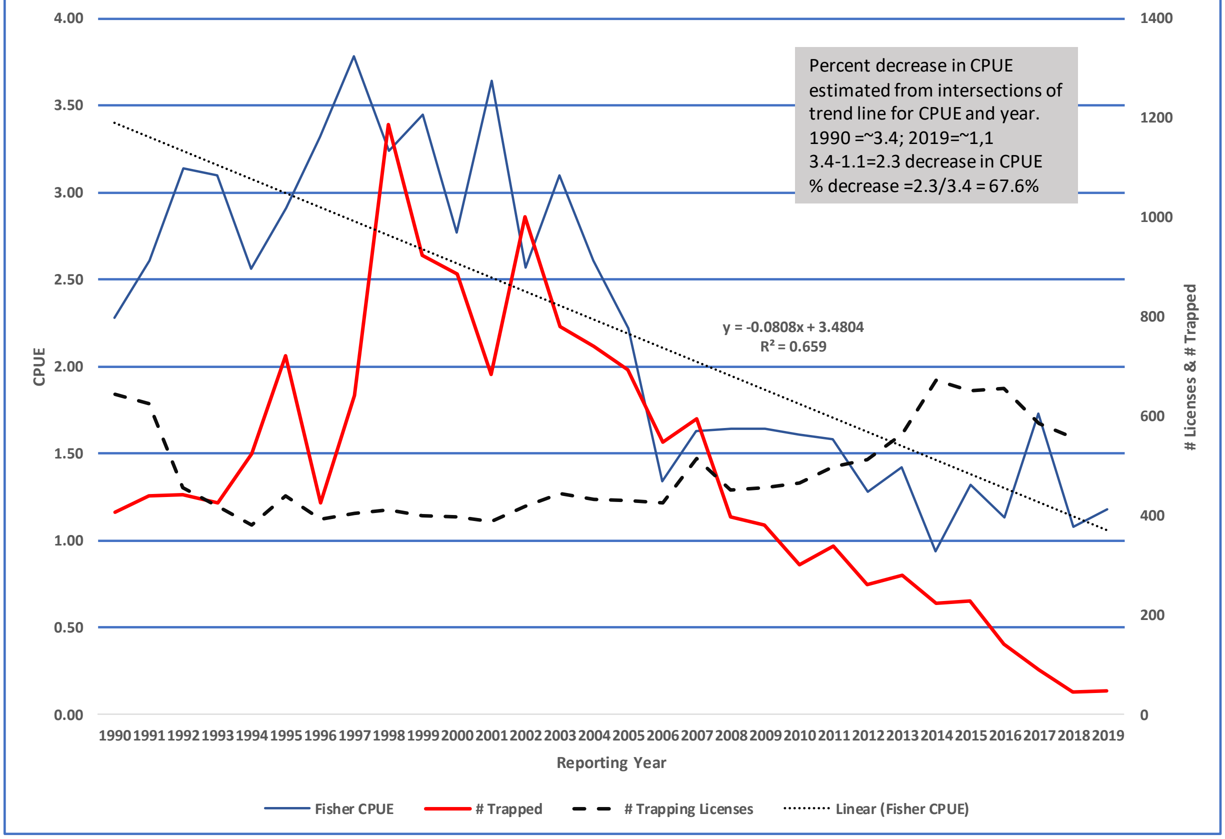
Methods

CPUE data for the last 30 years (1990-2019) were analyzed for trends using the trend function in Excel™. In addition, the differences in CPUE at five-year intervals were compared using a t-test (Excel™ t-test function) to evaluate whether differences in CPUE over time were statistically significant.[2] Also, the fisher harvest over the recent few years was compared statistically to the harvest over the last 30 years to determine whether recent results are representative of a long-term sustainable population.

Results

CPUE for fisher from 1990-2019 was plotted on an x-y chart and fitted to a linear trend line (Figure 1). The fit was reasonably good (R^2=0.66) meaning a linear trend explains 65% of the variability around the mean of the data. The fit for the data from 1997-2019 was even better (R^2=0.79) meaning a linear trend explains 79% of the variability around the mean of the data (Bosworth 2019).

Figure 1. Fisher CPUE 1990-2019



Percent decrease in CPUE estimated from intersections of trend line for CPUE and year.
1990 =~3.4; 2019=~1,1
3.4-1.1=2.3 decrease in CPUE
% decrease =2.3/3.4 = 67.6%

CPUE for fisher also was tabulated for the reporting years[3] 1990-2019 (Exhibit 1) and then grouped by five-year intervals, i.e., 1990-1994, 1995-1999, etc. (Table 1). t-tests were then conducted comparing each 5-year interval to all other 5-year intervals (Tables 2 and 3). The result of these t-tests indicated "highly significant" differences ($p \leq 0.001$) between each of the most recent three 5-year intervals (2005-2019) and each of the three 5-year intervals (1990-2004) prior to 2004. These results are "highly

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[2] A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups.

[3] All years refer to the year that the data were reported.

significant" which means that there is less than a 1 in 1000 chance that the null hypothesis, i.e., that there is no difference in values for CPUE in these 5-year intervals, is true. In addition, the results indicated that the CPUE throughout the most recent 15 years (2005-2019) is statistically the same.

Table 1. Fisher CPUE by year listed by 5-year interval.

1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
2.28	2.91	2.77	2.22	1.61	1.32
2.61	3.32	3.64	1.34	1.58	1.13
3.14	3.78	2.57	1.63	1.28	1.73
3.10	3.24	3.10	1.64	1.42	1.08
2.56	3.45	2.61	1.64	0.94	1.18

Table 2. p-values[4] comparing CPUE over 5-year periods to each other using a t-test assuming 2-tailed test and equal variances (homoscedastic). The null hypothesis is that there is no difference in CPUE over any of the 5-year periods.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.024674	0.462057	0.001428	0.000158	0.000103
1995-1999	0.024674		0.138141	0.000038	0.000006	0.000004
2000-2004	0.462057	0.138141		0.000960	0.000146	0.000102
2005-2009	0.001428	0.000038	0.000960		0.119676	0.068751
2010-2014	0.000158	0.000006	0.000146	0.119676		0.657306
2015-2019	0.000103	0.000004	0.000102	0.068751	0.657306	

Table 3. Significance of differences in CPUE over 5-year intervals.
Values with $p \geq 0.05$ (highlighted) are not significant.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.025	0.462	0.001	<.001	<.001
1995-1999	0.025		0.138	<.001	<.001	<.001
2000-2004	0.462	0.138		0.001	<.001	<.001
2005-2009	0.001	<.001	0.001		0.120	0.069
2010-2014	<.001	<.001	<.001	0.120		0.657
2015-2019	<.001	<.001	<.001	0.069	0.657	

The plot of fisher harvest (total number trapped) from 1928 to the present revealed substantial variability that appeared to have an inverse relationship to the number of trapping licenses (Figure 2).[5] More importantly, these data show that the number of fishers were so low during two periods that the trapping season had to be closed. The fisher season was closed from 1934 until 1961. As the fisher population rebounded, the season was opened in 1961 and remained open until 1977 when it was closed again for two years.

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[4] A p-value is the probability of obtaining results as extreme as the observed results assuming that the null hypothesis is correct, i.e., that there no significant differences. The smaller the p-value the stronger the evidence in favor of the alternative hypothesis, i.e., that there are significant differences.

[5] A 6-year study in South Central Maine by the Maine Cooperative Research Unit utilizing 76 radio-collared fishers showed that where trapping is permitted, it is the major cause of fisher mortality--in that study, 80% of the fisher mortality was due to trapping (Krohn 1993).

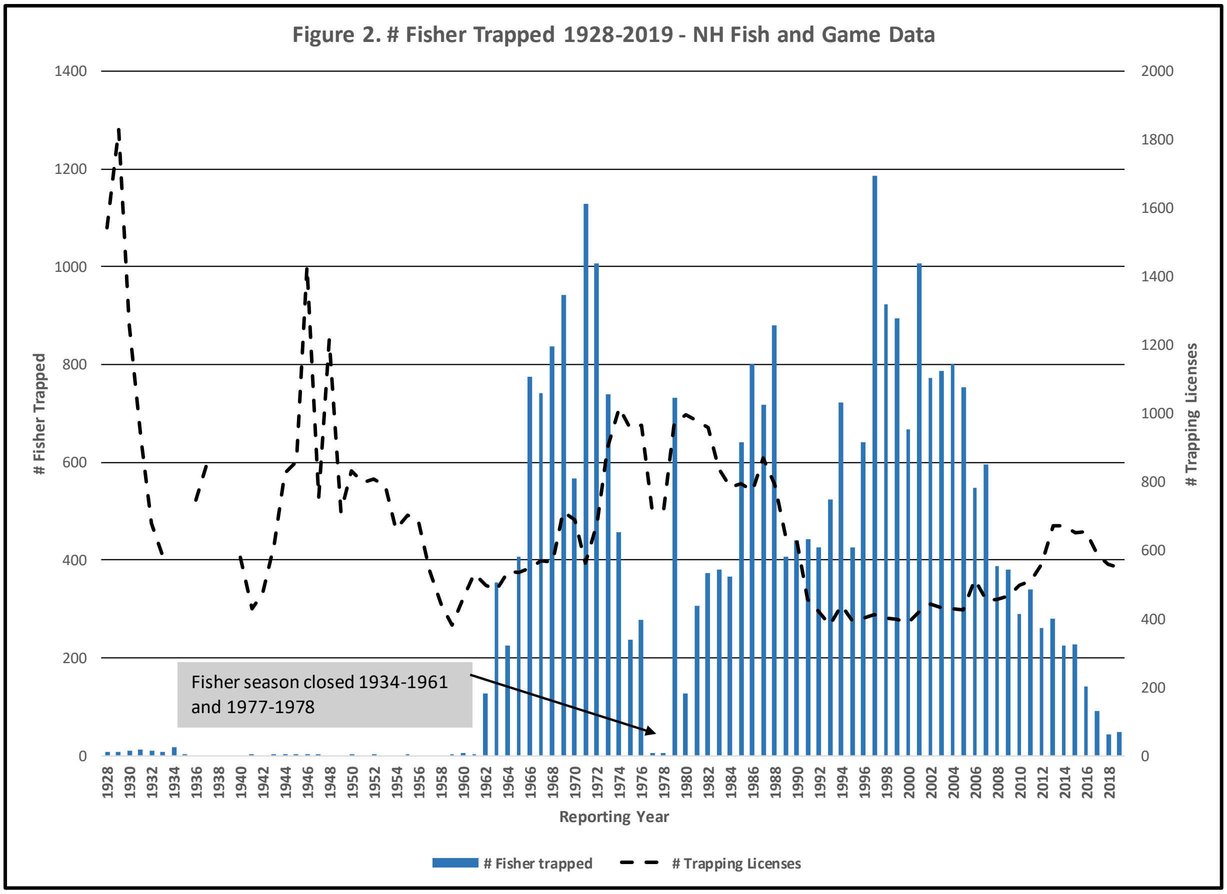
Figure 2. # Fisher Trapped 1928-2019 - NH Fish and Game Data

Fisher season closed 1934-1961 and 1977-1978

Discussion

Trends in CPUE and Total Harvest

Figure 1 depicts a significant trend of declining CPUE from 1990 to the present. Using the intercepts of the CPUE trend line with the reporting year, the decrease in the fisher CPUE from 1990-2019 based upon a linear model is approximately 68%. Examination of Figure 1 also indicates that if only the data from about 1997 through 2019 was used the estimated decline would be even greater. In fact, that period was evaluated in my recent testimony (Bosworth 2019) and the estimated decline from 1997 through 2019 was 78% (R^2=0.79).

The t-test results confirm that there has been a "highly significant" decrease in CPUE since about 2005 until the present (Tables 1, 2 and 3). CPUE in each of the recent five-year periods, 2005-2009, 2010-2014 and 2015-2019, was significantly lower ($p \leq 0.001$) than CPUE in each of the earlier five-year periods, 1990-1994, 1995-1999, and 2000-2004. These corroborate the trend analysis, i.e., that there has been a significant and consistent decline in fisher CPUE, particularly over the last 15 years. In addition, the null hypothesis was accepted only when comparing the most recent five-year periods. This means that there is no difference in CPUE between any of the three most recent five-year periods, i.e., the CPUE from 2005-2019 has been statistically the same.

Significance of Minor Change in Fisher CPUE in 2019

At a recent Commission meeting discussing rule-making for the next biennium, it was stated that because there was an "uptick" in fisher CPUE in 2019 compared to 2018 (1.08 in 2018 versus 1.28 in 2019), there would be no need to consider changes to either the season length or bag limit for fisher. In my opinion this decision was not only short-sighted given the 30-year trend of declining CPUE and total harvest, but also reflects a lack of understanding of natural variability in environmental data.

Data on fisher CPUE, as does most environmental data, have a certain amount of "natural" variability associated with it. Such variability is also known as chance or random variation. There are numerous methods that can be used to describe the variation that is inherent to most data sets and differentiating it from real (statistically significant) differences. However, without examining apparent differences by comparing the range or standard deviation of the data set or evaluating change in numbers statistically, one cannot consider minor differences in annual data as reflecting real differences. The bottom line is that the so-called "uptick" in CPUE in 2019 was meaningless unless put into statistical perspective. As discussed previously, the t-tests conducted in this analysis confirm that all the CPUE data from about 2004 to 2019 are not statistically different from one another but reflect a highly significant difference from all the five-year periods from 1990-2014. Thus, the decision not to modify the fisher season or bag limits on the premise that the CPUE in 2019 was higher than 2018 is not supported by any data. More weight should have been placed on the fact that there is and has been a significant declining trend in fisher CPUE for three decades.

Making Wildlife Management Decisions When Ignoring a Shifting Baseline

Managing wildlife resources is particularly difficult, if not impossible, when the sustainable baseline population of these resources is unknown. But exactly what is the baseline abundance for a sustainable population of fishers? Unfortunately, no one, including NH F&G, knows for certain! For wildlife management to be effective, an understanding of sustainable baseline is critical. NH Fish and Game has made a decision to maintain the status quo on fisher season and bag limits by only comparing recent population data to population data a couple years back assuming that to be the appropriate baseline population. However, when dealing with a population that is in decline large, long-term changes are masked when only looking back a couple years. This is exactly what is happening with the fisher. **This is the phenomenon of the "shifting baseline"** (See Soga et al. 2018 as an entry into the literature).

Numerous examples of how management of fishery and wildlife resources without considering a "shifting baseline" has led to population instability and crashes. In fact, this appears to have happened with the fisher population in the late 70's (Figure 2). Ignoring the obvious trend of a declining fisher population, even more trapping licenses were sold during that period and the fisher population declined to a point where the season had to be closed. This pattern appears to be repeating itself today (Figure 2). This outcome is not only a consequence to the fisher population, it also has ramifications to the entire ecosystem of which the fisher is a key component.

While NH Fish and Game may not know exactly what the sustainable baseline population for fisher may be, it would be far more realistic to consider the last 30 years of fisher harvest data and compare the most recent data to that as opposed to just concluding that 2019 CPUE exceeded 2018 CPUE. As an example, consider that the average annual fisher harvest since 1980 was 493 animals (Exhibit 2). The standard deviation during that period was 289 animals resulting in a 95% confidence interval of 390-597 animals (Figure 3). This means that any harvest result outside that range is significantly lower or higher than the population average which, since we don't have other data, we can consider a surrogate for a sustainable population. The total harvest in 2019 was 48 which is 88% fewer animals than the lower 95% confidence limits over the last 30 years. In fact, one would have to go back to 2008 when 397 animals were trapped to be within the 95% confidence interval of the last 30 years. Clearly, deciding to continue full speed ahead with the current season and bag limits for fisher ignores reality.

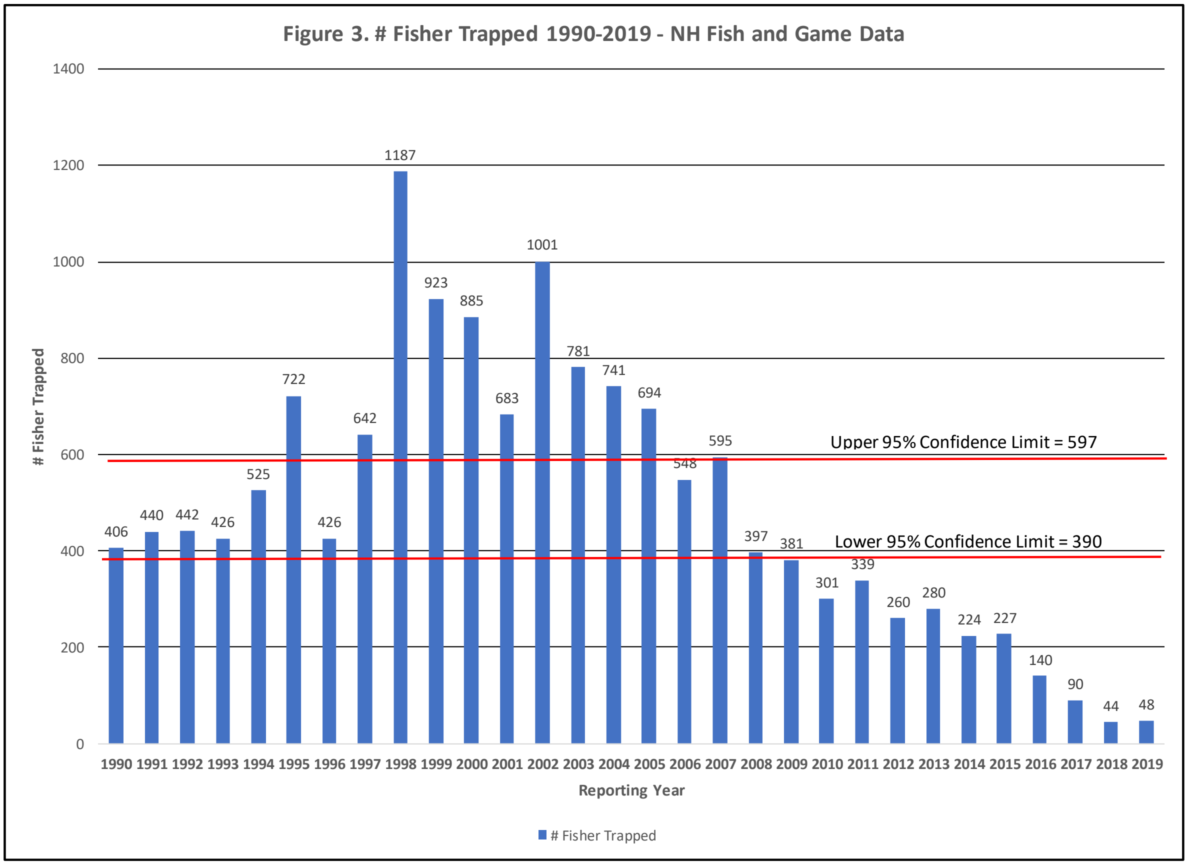
Figure 3. # Fisher Trapped 1990-2019 - NH Fish and Game Data

Conclusion

Based upon the trend in fisher CPUE and harvest data, it is apparent that the fisher population cannot support continued trapping pressure and be sustainable.

While there may be other uncontrolled variables, e.g., disease, weather, roadkill etc., that may help explain the apparent decline in the fisher population, trapping and hunting pressure are the only sources of mortality over which the Commission has some control, i.e. by closing seasons or adjusting bag limits. Using these management tools, in fact, is the primary means by which the Commission can fulfil its statutory responsibility of assuring a healthy, sustainable population of wildlife species. The Commission is well acquainted with the concept of adjusting seasons or bag limits to respond to changes in the abundance of other game species; whitetail deer, bear and wild turkey have been successfully managed to maintain a reasonably sustainable harvest over many years. Now is the time to apply these same principles to furbearers like the fisher.

References

Bosworth, W. 2019. Declining Populations of New Hampshire's Predators Highlights Wildlife Governance Biases. Testimony before the NH Fish and Game Commission, December 11, 2019.

Krohn, W. 1993. "Do the Pieces Fit, Understanding a Harvested Fisher Population". Maine Fish & Wildlife Magazine Vol 35 No. 3.

Soga, M., & Gaston, K. J. 2018. Shifting baseline syndrome: causes, consequences, and implications. Frontiers in Ecology and the Environment, 16(4), 222-230.

Exhibit 1. CPUE for Furbearers from 1990-2019. NH Fish and Game Harvest Summary Reports.

Season (Reporting Year)	Catch per 100 Trap Nights (CPUE)								
	Beaver	Muskrat	Otter	Mink	Raccoon	Coyote	Fisher	Gray Fox	Red Fox
1990	5.90	7.96	3.39	1.16	18.04	1.15	2.28	4.43	2.19
1991	7.33	10.80	2.39	1.58	17.58	1.36	2.61	1.74	2.24
1992	6.51	7.34	2.08	1.21	24.94	1.64	3.14	1.09	1.93
1993	9.74	7.69	2.06	1.32	19.21	1.76	3.10	0.91	2.01
1994	6.58	6.92	1.43	1.01	20.91	1.81	2.56	1.37	1.99
1995	7.91	6.90	2.02	1.76	14.40	1.18	2.91	0.94	2.66
1996	7.66	6.73	2.21	1.75	26.50	1.83	3.32	1.42	1.86
1997	8.51	10.20	2.29	1.77	24.50	3.00	3.78	1.98	2.78
1998	7.04	7.90	1.19	2.40	30.60	2.32	3.24	2.04	2.36
1999	9.28	11.20	2.81	4.20	8.22	2.01	3.45	2.35	2.04
2000	9.87	10.10	2.28	2.72	3.62	1.34	2.77	1.77	2.55
2001	8.85	7.97	1.60	1.68	3.87	2.47	3.64	1.76	2.21
2002	9.99	8.97	2.12	2.25	3.97	2.86	2.57	1.86	2.67
2003	8.55	8.91	2.15	1.85	3.16	2.26	3.10	1.54	1.95
2004	8.82	10.60	2.33	1.73	3.38	1.68	2.61	1.37	2.17
2005	8.97	10.60	1.76	2.19	2.57	1.85	2.22	1.52	1.86
2006	6.38	7.76	1.58	2.07	2.46	1.77	1.34	0.86	1.52
2007	7.31	5.41	1.58	1.30	1.78	2.77	1.63	1.12	2.03
2008	8.82	7.28	2.11	2.64	3.17	2.30	1.64	1.24	1.64
2009	7.52	5.87	1.63	2.09	2.67	2.30	1.64	1.30	1.66
2010	7.62	6.24	2.48	2.07	3.57	2.00	1.61	1.20	1.41
2011	8.82	5.73	1.97	2.08	3.18	1.92	1.58	1.52	1.51
2012	6.86	5.64	1.55	1.99	3.07	2.40	1.28	1.33	1.80
2013	5.29	4.85	1.26	1.43	2.49	1.46	1.42	1.07	1.34
2014	5.96	5.07	1.55	1.09	2.72	1.21	0.94	0.92	1.13
2015	5.52	4.70	1.96	1.91	2.20	1.21	1.32	0.69	1.12
2016	4.71	5.31	1.46	1.47	3.41	1.06	1.13	0.77	0.88
2017	7.23	5.70	2.77	1.57	1.62	1.41	1.73	0.55	0.83
2018	6.92	6.53	1.65	1.75	3.68	1.52	1.08	1.02	1.63
2019	8.21	6.94	3.45	2.01	3.15	2.21	1.18	1.75	2.08

Exhibit 2. Total Furbearer Harvest 1990-2019. NH Fish and Game Harvest Summary Reports.

Season (Reporting Year)[1]	Beaver	Muskrat	Otter	Mink	Raccoon	Coyote	Fisher	Gray Fox	Red Fox
1990	3098	3764	329	465	890	169	406	58	504
1991	2589	2381	261	358	796	155	440	63	415
1992	3372	3886	316	537	965	227	442	76	426
1993	2059	2525	285	381	854	260	426	86	381
1994	3612	2273	405	441	994	298	525	76	378
1995	5901	4389	504	513	888	342	722	97	444
1996	4048	2731	317	386	902	380	426	75	343
1997	4752	2976	451	587	519	345	642	129	264
1998	3980	3980	344	429	684	398	1187	104	324
1999	3784	3517	288	453	923	318	923	120	195
2000	3412	1714	291	416	374	279	885	89	181
2001	2879	2169	244	262	244	358	683	75	208
2002	4313	3577	386	616	555	556	1001	183	409
2003	2280	1458	275	367	415	532	781	188	364
2004	2626	1495	321	304	433	654	741	215	454
2005	2366	2118	279	314	55	622	694	104	381
2006	3057	2109	367	292	350	464	548	71	239
2007	3377	2651	345	449	495	560	595	190	337
2008	2270	1587	214	477	557	416	397	134	233
2009	2758	1212	235	292	423	524	381	189	290
2010	2616	1794	257	280	446	466	301	201	274
2011	2347	1347	242	353	546	412	339	193	249
2012	3255	1804	386	268	410	427	260	129	226
2013	2491	1850	306	399	623	534	280	181	307
2014	2329	1743	256	289	817	499	224	187	271
2015	2054	1450	177	269	487	440	227	99	210
2016	2246	1452	166	174	463	501	140	109	180
2017	1202	554	154	111	336	385	90	62	115
2018	1140	528	97	91	302	402	44	89	156
2019	1361	544	89	77	352	347	48	39	141
Total per species since 1990	87,574	65,578	8,587	10,650	17,098	12,270	14,798	3,611	8,899

The Case for Decreasing Bag Limits of Red and Gray Fox

Weldon Bosworth, Ph.D.

March 30, 2020

This paper presents evidence supporting a decision that the bag limits for foxes should be decreased. This evidence includes:

1) A significant decline in the number of red and gray fox trapped over the last 30 years;
2) A significant decline in red and gray fox CPUE over the last 30 years;
3) A statistical comparison of Catch per Unit Effort (CPUE)[1] over the last 30 years based upon five-year intervals which indicates that the CPUE for most recent 15 years is significantly lower than the 15 years from 1990-2004 for red fox and significantly lower for several of those five-year periods for the gray fox; and
4) A statistical comparison that documents that the red fox harvest has been significantly below the lower 95% confidence limit of the mean harvest since 2014 and the gray fox harvest has been below the lower 95% confidence limit of the mean since 2016.

Additionally, a cautionary note on how failure to act now by reducing the bag limit on red and gray foxes is one step further along a path where the negative consequences of making wildlife management decisions within the context of a shifting baseline become a reality.

Introduction

Changes in red and gray fox CPUE and harvest data for the last 30 years, 1990-2019, were evaluated using trend analysis and hypothesis testing. The CPUE data were taken directly from the Annual Harvest Summaries on the NH Fish and Game website https://www.wildlife.state.nh.us/hunting/harvest-summary.html.

CPUE is an indirect measure of the abundance of a target species. Variation in CPUE is inferred to reflect changes to the target species' true abundance. CPUE has several advantages over other methods of measuring abundance, e.g., observation transects, trail cameras or aerial counts. The data are relatively easy to collect and analyze, even for non-scientists. One major advantage of using CPUE to infer population abundance is that the sources or magnitude of other variables that affect mortality, e.g., disease, interspecific competition, roadkill, etc., do not have to be known or quantified. Provided the unit of effort is standardized, in this case catch per 100 trap nights, the relationship between the CPUE and the inferred population abundance remains constant and comparison of inferred population size over time or among areas being managed can be made. CPUE is widely used throughout the world to monitor and manage both wildlife and fish populations.

Changes in red and gray fox CPUE and harvest data over the last 30 years were also compared statistically to ascertain whether, even within the context of annual variability, CPUE in recent years is representative of a sustainable population.

Lastly, total number of red and gray fox trapped per year from 1928 through 2019 were examined to see whether there was any pattern that could be instructive in making management decisions for the red and gray fox populations today.

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[1] Catch per Unit Effort is equivalent to number of animals trapped per 100 trap nights.

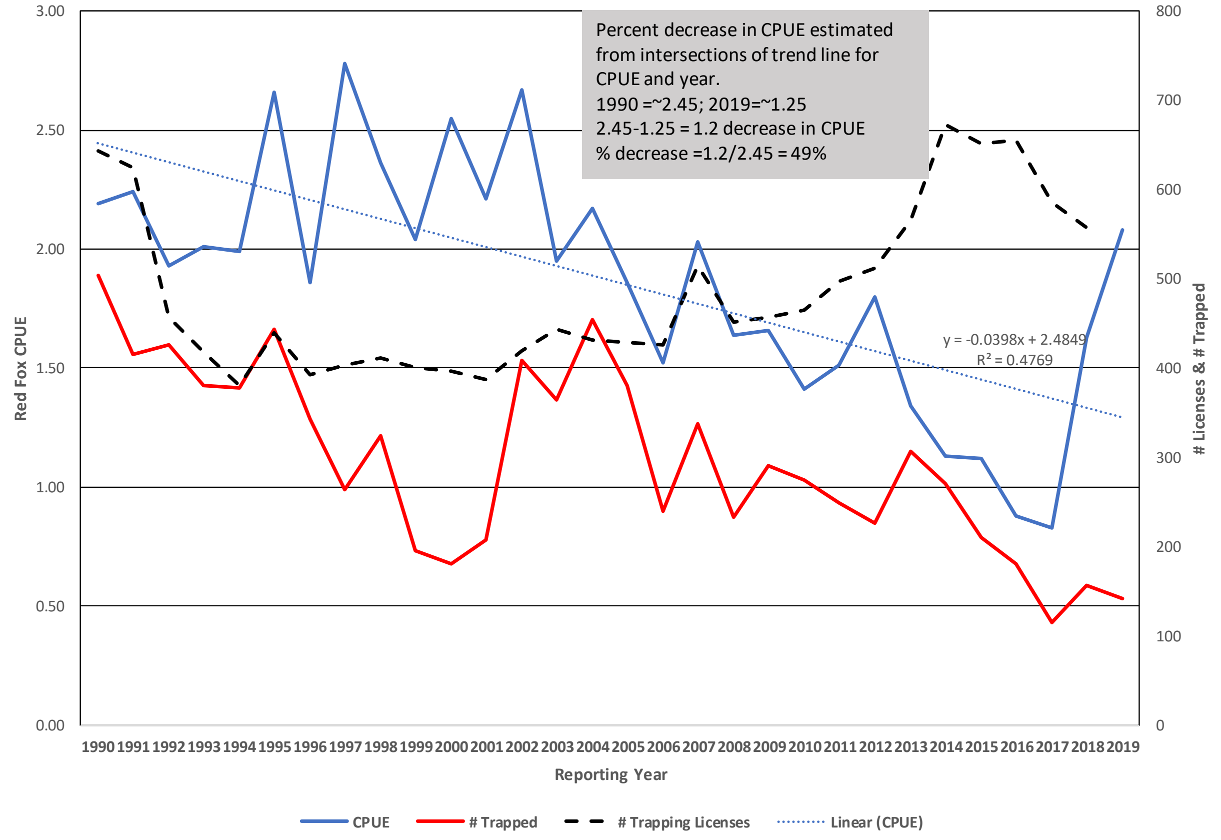
Methods

CPUE data for the last 30 years (1990-2019) were analyzed for trends using the trend function in Excel™. In addition, the differences in CPUE at five-year intervals were compared using a t-test (Excel™ t-test function) to evaluate whether differences in CPUE over time were statistically significant.[2] Also, both the red and gray fox harvest over the recent few years was compared statistically to the harvest over the last 30 years to determine whether recent results are representative of a long-term sustainable population.

Results

CPUE for red fox and gray fox from 1990-2019 was plotted on an x-y chart and fitted to a linear trend line (Figures 1 and 2, respectively). The fit was moderate (R^2=0.48) for the red fox meaning a linear trend explains 48% of the variability around the mean in the data. The fit was poor (R^2=0.24) for the gray fox meaning a linear trend explains 24% of the variability around the mean of the data. The fit of the data from 1997-2019 to a linear trend was even better (R^2=0.61) for the red fox and R^2=0.56 for the gray fox which means a linear trend explains 61% of the variability around the mean of the data for the red fox and 56% of the variability around the mean for the gray fox (Bosworth 2019).

Figure 1. Red Fox Trapped 1990-2019 -NH Fish and Game Data



Percent decrease in CPUE estimated from intersections of trend line for CPUE and year.
1990 =~2.45; 2019=~1.25
2.45-1.25 = 1.2 decrease in CPUE
% decrease =1.2/2.45 = 49%

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[2] A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups.

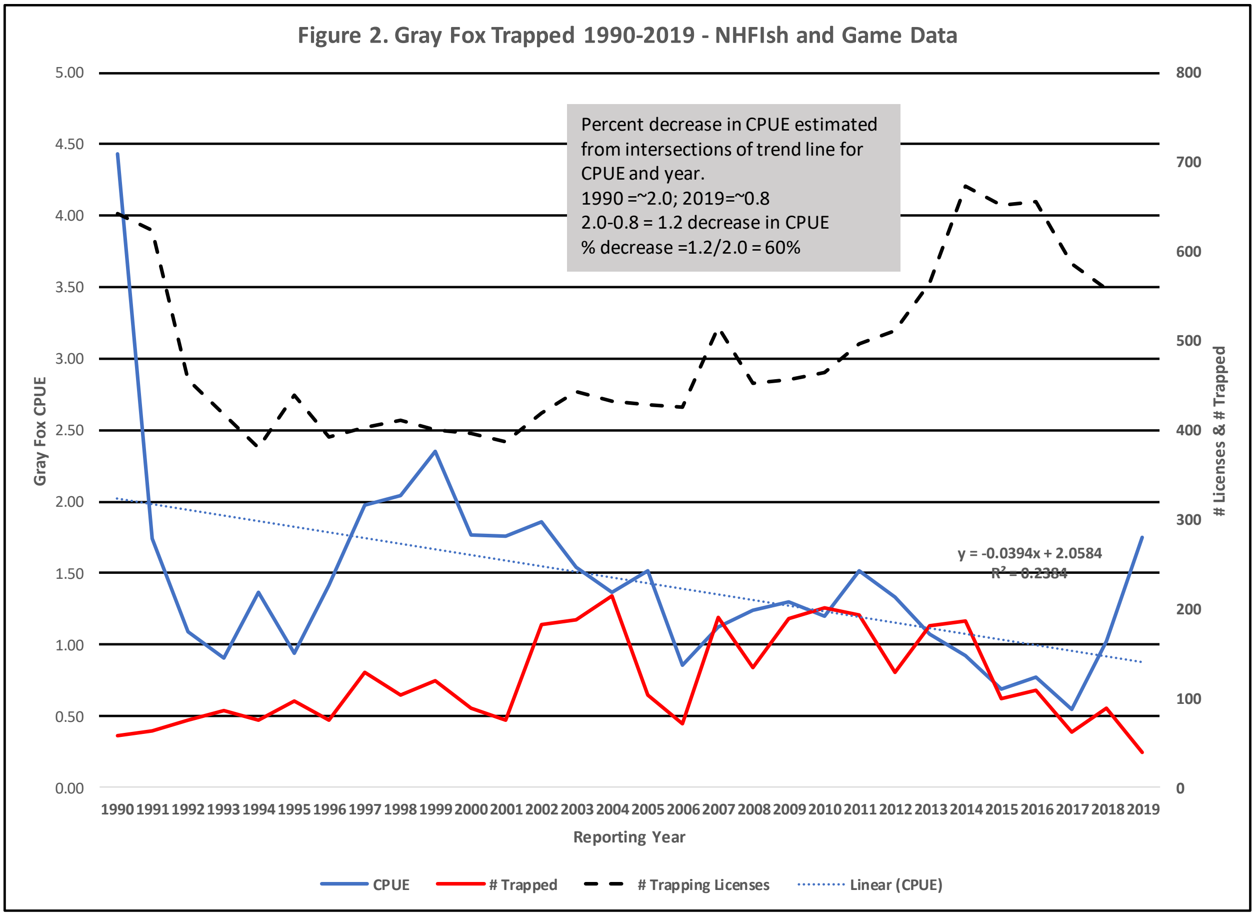

Figure 2. Gray Fox Trapped 1990-2019 - NHFIsh and Game Data

Percent decrease in CPUE estimated from intersections of trend line for CPUE and year.
1990 =~2.0; 2019=~0.8
2.0-0.8 = 1.2 decrease in CPUE
% decrease =1.2/2.0 = 60%

CPUE for the red and gray fox also was tabulated for the reporting years[3] 1990-2019 (Exhibit 1) and then grouped by five-year intervals, i.e., 1990-1994, 1995-1999, etc. T-tests were then conducted comparing each 5-year interval to all other 5-year intervals. For red fox Table 1 tabulates CPUE in five-year intervals. Tables 2 and 3 provide p-values[4] and significance of p-values for red fox. The result of these t-tests indicated significant differences ($p \leq 0.05$) between each of the most recent three 5-year intervals (2005-2019) and each of the three 5-year intervals prior to 2004 (1990-2004). These results are "significant" which means that there is less than a 5% chance that the null hypothesis, i.e., that there is no difference in values for CPUE in these 5-year intervals, is true.

Table 1. Red fox CPUE by year listed by 5-year interval.

1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
2.19	2.66	2.55	1.86	1.41	1.12
2.24	1.86	2.21	1.52	1.51	0.88
1.93	2.78	2.67	2.03	1.80	0.83
2.01	2.36	1.95	1.64	1.34	1.63
1.99	2.04	2.17	1.66	1.13	2.08

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[3] All years refer to the year that the data were reported.

[4] A p-value is the probability of obtaining results as extreme as the observed results assuming that the null hypothesis is correct. The smaller the p-value the stronger the evidence in favor of the alternative hypothesis, i.e., that there are significant differences between the groups compared.

Table 2. p-values[5] comparing red fox CPUE over 5-year periods to each other using a t-test assuming 2-tailed test and equal variances (homoscedastic). The null hypothesis is that there is no difference in CPUE over any of the 5-year periods.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.186953	0.138847	0.016140	0.000981	0.014802
1995-1999	0.186953		0.894643	0.016361	0.002432	0.008376
2000-2004	0.138847	0.894643		0.007422	0.000946	0.006335
2005-2009	0.016140	0.016361	0.007422		0.065087	0.128365
2010-2014	0.000981	0.002432	0.000946	0.065087		0.634958
2015-2019	0.014802	0.008376	0.006335	0.128365	0.634958	

Table 3. Significance of differences in CPUE over 5-year intervals. Values with p≥0.05 (highlighted) are not significant.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.187	0.139	0.016	0.001	0.015
1995-1999	0.187		0.895	0.016	0.002	0.008
2000-2004	0.139	0.895		0.007	0.001	0.006
2005-2009	0.016	0.016	0.007		0.065	0.128
2010-2014	0.001	0.002	0.001	0.065		0.635
2015-2019	0.015	0.008	0.006	0.128	0.635	

For gray fox, Table 4 tabulates CPUE in five-year intervals. Tables 5 and 6 provide p-values and significance of p-values for gray fox. The result of these t-tests indicated only a few instances that the null hypothesis was rejected. The 5-year periods from 2005-2009 and 2010-2014 were significantly (p≤0.05) different than 2000-2004; 2015-2019 was significantly different (p≤0.05) than both 1995-1999 and 2000-2004 (Tables 5 and 6).

Table 4. Gray fox CPUE by year listed by 5-year interval.

1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
4.43	0.94	1.77	1.52	1.20	0.69
1.74	1.42	1.76	0.86	1.52	0.77
1.09	1.98	1.86	1.12	1.33	0.55
0.91	2.04	1.54	1.24	1.07	1.02
1.37	2.35	1.37	1.30	0.92	1.75

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[5] A p-value is the probability of obtaining results as extreme as the observed results assuming that the null hypothesis is correct, i.e., that there no significant differences. The smaller the p-value the stronger the evidence in favor of the alternative hypothesis, i.e., that there are significant differences.

Table 5. p-values comparing gray fox CPUE over 5-year periods to each other using a t-test assuming 2-tailed test and equal variances (homoscedastic). The null hypothesis is that there is no difference in CPUE over any of the 5-year periods.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.821039	0.713601	0.316347	0.315780	0.199079
1995-1999	0.821039		0.755365	0.084858	0.083014	0.043163
2000-2004	0.713601	0.755365		0.012404	0.010835	0.015813
2005-2009	0.316347	0.084858	0.012404		1.000000	0.322101
2010-2014	0.315780	0.083014	0.010835	1.000000		0.317803
2015-2019	0.199079	0.043163	0.015813	0.322101	0.317803	

Table 6. Significance of differences in gray fox CPUE over 5-year intervals.
Values with p≥0.05 (highlighted) are not significant.

	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
1990-1994		0.821	0.714	0.316	0.316	0.199
1995-1999	0.821		0.755	0.085	0.083	0.043
2000-2004	0.714	0.755		0.012	0.011	0.016
2005-2009	0.316	0.085	0.012		1.000	0.322
2010-2014	0.316	0.083	0.011	1.000		0.318
2015-2019	0.199	0.043	0.016	0.322	0.318	

The red fox and gray fox harvest[6] (total number trapped) from 1928 to the present revealed substantial variability (Figure 3). After the fox populations recovered from a mange epidemic in the southern part of the state (Silver 1974) in the mid 1960's the increase in trapping pressure (judging from the increase in trapping licenses; from a low of around 400 to about 1000) resulted in a decline in number of foxes of both species harvested by the late 1980's.

More importantly, these data show that the number of foxes (of both species) harvested has declined dramatically since the early 1980's, from a total of over 2100 in 1982 to only 164 last year, a decrease of over 92%. It appears from these data the declines in harvest follow an increase in trapping pressure as reflected in the number of trapping licenses issued.

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[6] Red fox and gray fox have been combined in this chart as the species were not differentiated in trapping results until 1971.

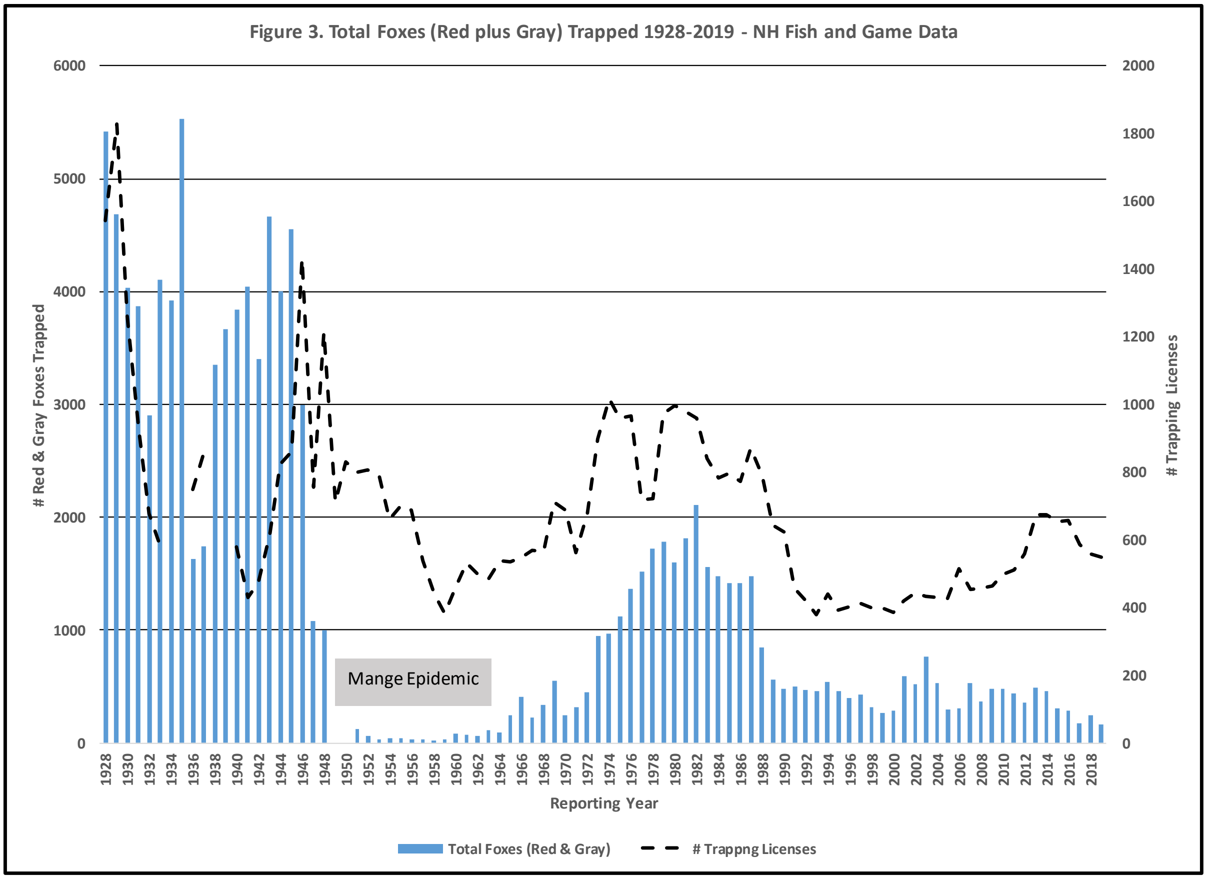


Figure 3. Total Foxes (Red plus Gray) Trapped 1928-2019 - NH Fish and Game Data

Discussion

Trends in CPUE and Total Harvest

Figure 1 depicts a significant trend of declining CPUE from 1990 to the present for the red fox. Using the intercepts of the CPUE trend line with the reporting year, the decrease in the red fox CPUE from 1990-2019 based upon a linear model is approximately 49%. Examination of Figure 1 also indicates that if only the data from about 1997 through 2019 was used the estimated decline would be even greater. In fact, that period was evaluated in my recent testimony and the estimated decline from 1997 through 2019 was 56% (R^2=0.61) (Bosworth 2019).

For the gray fox, the decrease in CPUE from 1990 to the present was 60% (R^2=0.24) (Figure 2). If only the data from about 1997 through 2019 was used the estimated decline would be about the same (58%; R^2=0.56) (Bosworth 2019).

The t-tests confirm that there has been a “significant” decrease in red fox CPUE since about 2005 until the present (Tables 2 and 3). As previously discussed CPUE in each of the recent five-year periods, 2005-2009, 2010-2014 and 2015-2019, was significantly different ($p \leq 0.05$) than CPUE in each of the earlier five-year periods, 1990-1994, 1995-1999, and 2000-2004). In addition, the null hypothesis was accepted only when comparing the most recent five-year periods. This means that there is no difference in red fox CPUE between any of the three most recent five-year periods. These results corroborate the trend analysis. There has been a significant and consistent decline in red fox CPUE, particularly over the last 15 years.

For the gray fox the results of the t-tests were less dramatic (Tables 5 and 6). There were only a few instances that the null hypothesis was rejected. The 5-year periods from 2005-2009 and 2010-2014 were significantly ($p \leq 0.05$) different than 2000-2004; 2015-2019 was significantly different ($p \leq 0.05$) than both 1995-1999 and 2000-2004. Although no consistent trends were obvious in the CPUE based upon the t-tests, the results did confirm a significant difference in the latest 5-year period compared to the two 5-year periods from 1995-2004. The results also confirm that there has been no significant difference in CPUE throughout the most recent 5-year periods, 2004-2019.

Significance of Minor Changes in Red and Gray Fox CPUE in 2019

At a recent Commission meeting discussing rule-making for the next biennium, it was observed that because the CPUE for both fox species had increased over the last two years this was evidence of an upwards trend and that therefore there would be no need to consider changes to either the season length or bag limit for fisher. This decision was not only short-sighted given the 30-year trend of declining CPUE and total harvest, particularly for the red fox, but also reflects a lack of understanding of natural variability in environmental data.

Data on red and gray fox CPUE, as does most environmental data, have a certain amount of "natural" variability associated with it. Such variability is also known as chance or random variation. There are numerous methods that can be used to describe the variation that is inherent to most data sets and differentiating it from real, i.e., statistically significant, differences. However, without examining apparent differences by comparing the range or standard deviation of the data set or evaluating change in numbers statistically, one cannot consider minor differences in annual data as reflecting real differences. The bottom line is that the increased CPUE for red and gray fox in 2018 and 2019 was meaningless unless put into statistical perspective. The t-tests conducted in this analysis confirm that the red fox and gray fox CPUE data from about 2004 to 2019 are not statistically different from one another (Tables 3 and 6). Thus, the decision not to modify the red fox or gray fox season or bag limits on the premise that the there was a real increase in CPUE in 2018 and 2019 is not supported by the data. More weight should have been placed on the fact that there is and has been a significantly declining trend in red fox CPUE for three decades and a decline in ray fox CPUE at least since 1997.

Making Wildlife Management Decisions When Ignoring a Shifting Baseline

Managing wildlife resources is particularly difficult, if not impossible, when the sustainable baseline population of these resources is unknown. But exactly what is the baseline abundance for a self-sustaining population of fishers? Unfortunately, no one, including NH F&G, knows for certain! For wildlife management to be effective, an understanding of sustainable baseline is critical. NH Fish and Game is making a decision to maintain the status quo on red and gray fox season and bag limits by only comparing recent population data to population data a couple years back assuming that to be the appropriate baseline population. However, when dealing with a population that is in decline large, long-term changes are masked when only looking back a couple years. This is exactly what is happening with the red fox and to a certain extent tot the gray fox. **This is the phenomenon of the "shifting baseline"** (See Soga et al. 2018 as an entry into the literature).

While NH Fish and Game may not know exactly what the sustainable baseline population for red fox and gray fox may be, it would be far more realistic to consider the last 30 years of their harvest data and compare the most recent data to that as opposed to just concluding that there was an apparent increase over the last two years.

As an example, consider that the average annual red fox harvest since 1980 was 297 animals (Exhibit 2). The standard deviation during that period was 103 animals resulting in a 95% confidence interval of 260-334 animals (Figure 4). This means that any harvest result outside that range is significantly lower or higher than the population average which, since we don't have other data, we can consider a surrogate for a sustainable population. The total harvest in 2019 was 129 which is <u>50% fewer animals</u> than the lower 95% confidence limits over the last 30 years. In fact, one would have to go back to 2014 when 271 animals were trapped to be within the 95% confidence interval of the last 30 years.

The average annual gray fox harvest since 1980 was 120 animals (Exhibit 2). The standard deviation during that period was 52 animals resulting in a 95% confidence interval of 102-139 animals (Figure 5). One would have to go back to 2016 when 109 animals were trapped to be within the 95% confidence interval of the last 30 years.

Clearly, basing the decision on current season and bag limits for the two fox species on just the last two year's data while ignoring how these latest data compared to longer term data is exactly what an understanding of the "shifting baseline" would caution against if the objective was to manage the populations for sustainability.

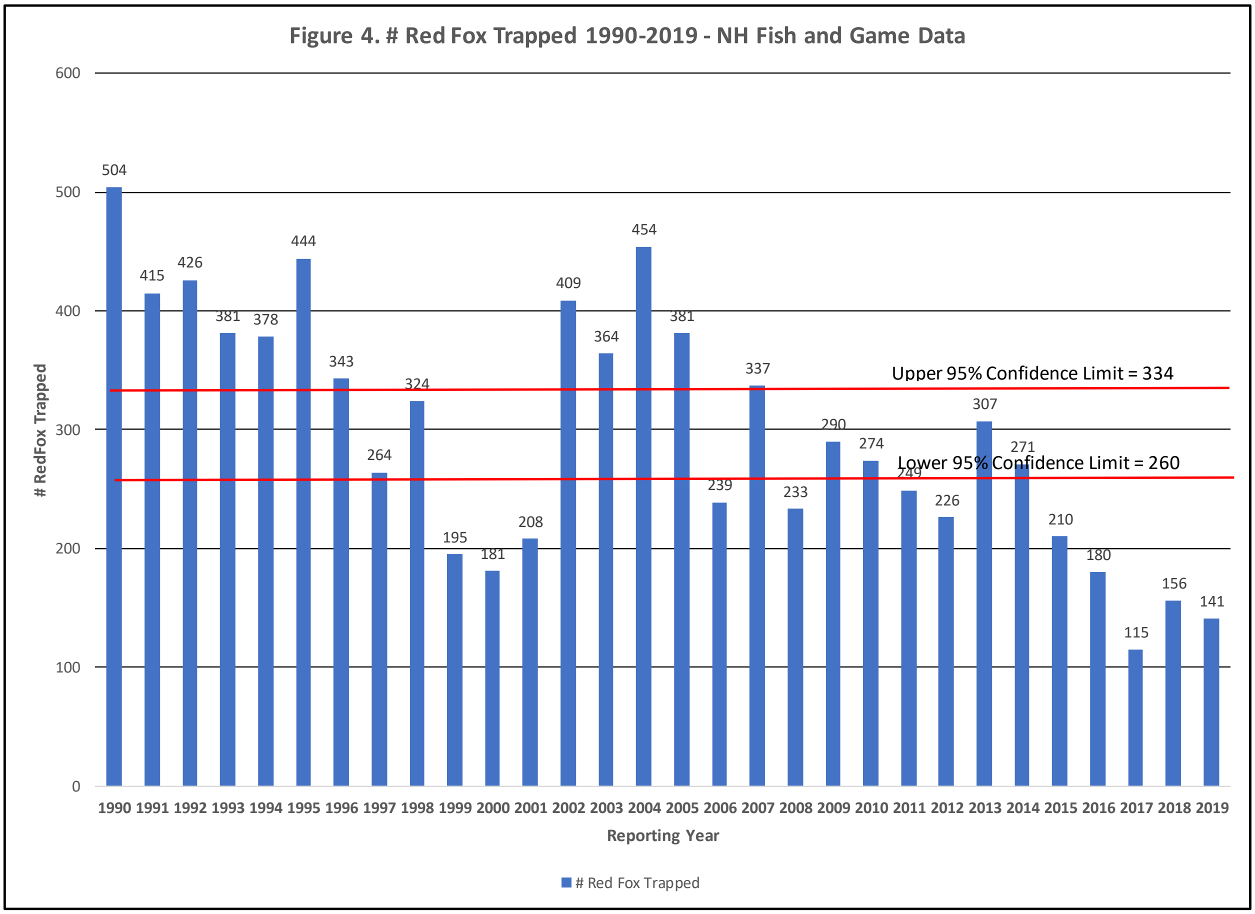
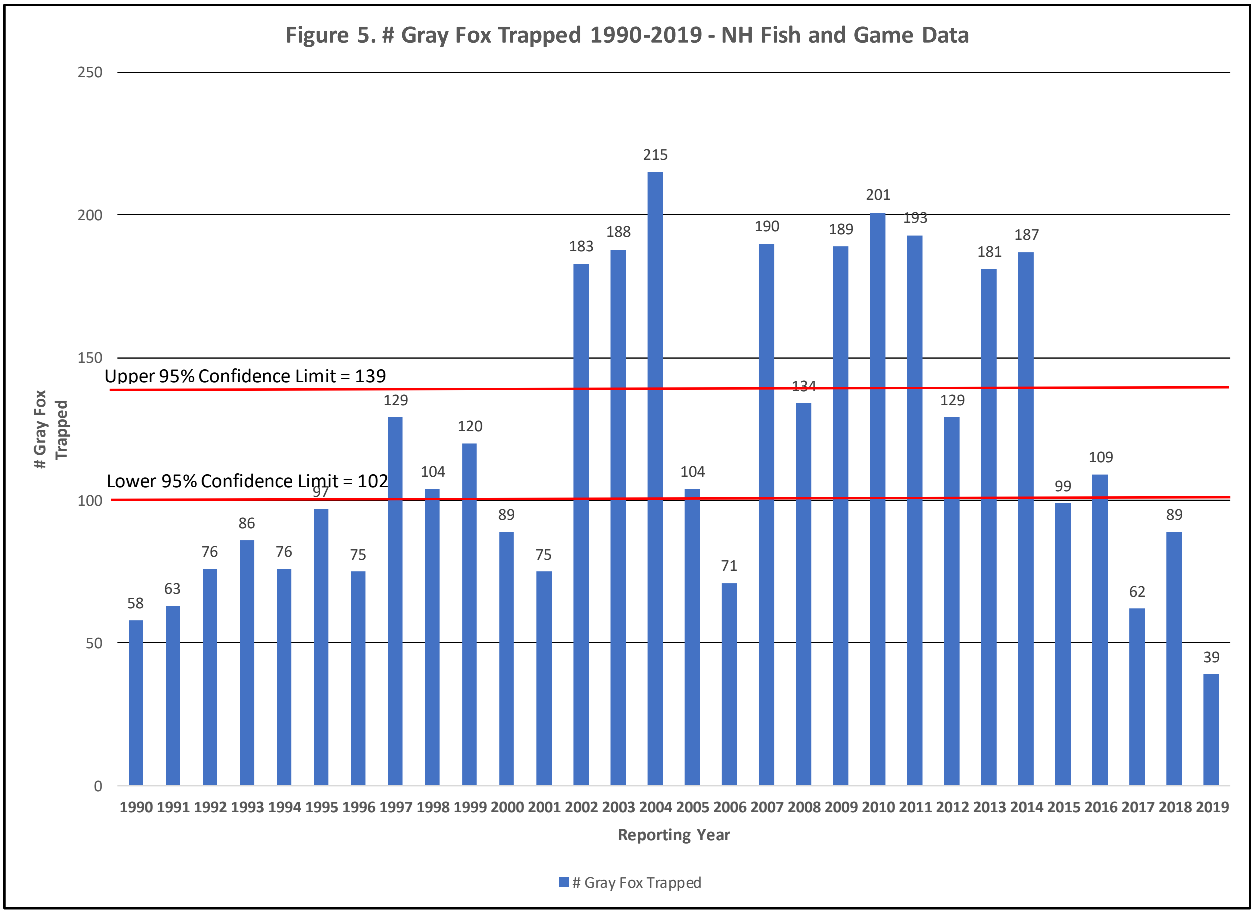


Figure 4. # Red Fox Trapped 1990-2019 - NH Fish and Game Data



Conclusion

Based upon these long-term trends in CPUE and harvest data the red fox and gray fox populations are under significant trapping pressure. As result, the population inferred from trends in CPUE has declined significantly over the last few years. In addition, based upon harvest data the numbers trapped in the last few years are below any conservative estimate of their sustainable population size.

While there may be other uncontrolled variables, e.g., disease, weather, roadkill etc., that may help explain the apparent decline in these populations, trapping and hunting pressure are the only sources of mortality over which the Commission has some control, i.e. by closing seasons or adjusting bag limits. Using these management tools, in fact, is the primary means by which the Commission can fulfil its statutory responsibility of assuring a sustainable, healthy population of wildlife species. The Commission is well acquainted with the concept of adjusting seasons or bag limits to respond to changes in the abundance of other game species; whitetail deer, bear and wild turkey have been successfully managed to maintain a reasonably sustainable harvest over many years. Now is the time to apply these same principles to furbearers like the red and gray fox.

Although data on the red and gray foxes suggests that while their population may not yet be at a point where closure of their season is required, the steady decline in CPUE and numbers harvested (Figures 1, 2 and 3) urges caution in any management decisions relating to season or bag limits. As discussed previously, using the last two years' CPUE data as evidence of a reversal in a long-term decline in their population is not supported, i.e., the CPUE data for neither the red fox nor the gray fox throughout these last 15 years are significantly different. In my opinion a prudent wildlife manager would decrease the red fox and gray fox bag limit to three per season, statewide, as was proposed in the last biennium. It was the appropriate decision then and nothing has changed in the two years since then that would support a less conservative decision. An objective person only must look at the combined harvest data for both the red and gray fox (Figure 3), to understand that their populations are not being managed sustainably as required by statute.

References

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Silver, H.1957.A History of New Hampshire Game and Furbearers. New Hampshire Fish and Game Department Survey Report Number 6.

Soga, M., & Gaston, K. J. 2018. Shifting baseline syndrome: causes, consequences, and implications. Frontiers in Ecology and the Environment, 16(4), 222-230.

Exhibit 1. CPUE for Furbearers from 1990-2019. NH Fish and Game Harvest Summary Reports.

Season (Reporting Year)	Catch per 100 Trap Nights (CPUE)								
	Beaver	Muskrat	Otter	Mink	Raccoon	Coyote	Fisher	Gray Fox	Red Fox
1990	5.90	7.96	3.39	1.16	18.04	1.15	2.28	4.43	2.19
1991	7.33	10.80	2.39	1.58	17.58	1.36	2.61	1.74	2.24
1992	6.51	7.34	2.08	1.21	24.94	1.64	3.14	1.09	1.93
1993	9.74	7.69	2.06	1.32	19.21	1.76	3.10	0.91	2.01
1994	6.58	6.92	1.43	1.01	20.91	1.81	2.56	1.37	1.99
1995	7.91	6.90	2.02	1.76	14.40	1.18	2.91	0.94	2.66
1996	7.66	6.73	2.21	1.75	26.50	1.83	3.32	1.42	1.86
1997	8.51	10.20	2.29	1.77	24.50	3.00	3.78	1.98	2.78
1998	7.04	7.90	1.19	2.40	30.60	2.32	3.24	2.04	2.36
1999	9.28	11.20	2.81	4.20	8.22	2.01	3.45	2.35	2.04
2000	9.87	10.10	2.28	2.72	3.62	1.34	2.77	1.77	2.55
2001	8.85	7.97	1.60	1.68	3.87	2.47	3.64	1.76	2.21
2002	9.99	8.97	2.12	2.25	3.97	2.86	2.57	1.86	2.67
2003	8.55	8.91	2.15	1.85	3.16	2.26	3.10	1.54	1.95
2004	8.82	10.60	2.33	1.73	3.38	1.68	2.61	1.37	2.17
2005	8.97	10.60	1.76	2.19	2.57	1.85	2.22	1.52	1.86
2006	6.38	7.76	1.58	2.07	2.46	1.77	1.34	0.86	1.52
2007	7.31	5.41	1.58	1.30	1.78	2.77	1.63	1.12	2.03
2008	8.82	7.28	2.11	2.64	3.17	2.30	1.64	1.24	1.64
2009	7.52	5.87	1.63	2.09	2.67	2.30	1.64	1.30	1.66
2010	7.62	6.24	2.48	2.07	3.57	2.00	1.61	1.20	1.41
2011	8.82	5.73	1.97	2.08	3.18	1.92	1.58	1.52	1.51
2012	6.86	5.64	1.55	1.99	3.07	2.40	1.28	1.33	1.80
2013	5.29	4.85	1.26	1.43	2.49	1.46	1.42	1.07	1.34
2014	5.96	5.07	1.55	1.09	2.72	1.21	0.94	0.92	1.13
2015	5.52	4.70	1.96	1.91	2.20	1.21	1.32	0.69	1.12
2016	4.71	5.31	1.46	1.47	3.41	1.06	1.13	0.77	0.88
2017	7.23	5.70	2.77	1.57	1.62	1.41	1.73	0.55	0.83
2018	6.92	6.53	1.65	1.75	3.68	1.52	1.08	1.02	1.63
2019	8.21	6.94	3.45	2.01	3.15	2.21	1.18	1.75	2.08

Exhibit 2. Total Furbearer Harvest 1990-2019. NH Fish and Game Harvest Summary Reports.

Season (Reporting Year)[1]	Beaver	Muskrat	Otter	Mink	Raccoon	Coyote	Fisher	Gray Fox	Red Fox
1990	3098	3764	329	465	890	169	406	58	504
1991	2589	2381	261	358	796	155	440	63	415
1992	3372	3886	316	537	965	227	442	76	426
1993	2059	2525	285	381	854	260	426	86	381
1994	3612	2273	405	441	994	298	525	76	378
1995	5901	4389	504	513	888	342	722	97	444
1996	4048	2731	317	386	902	380	426	75	343
1997	4752	2976	451	587	519	345	642	129	264
1998	3980	3980	344	429	684	398	1187	104	324
1999	3784	3517	288	453	923	318	923	120	195
2000	3412	1714	291	416	374	279	885	89	181
2001	2879	2169	244	262	244	358	683	75	208
2002	4313	3577	386	616	555	556	1001	183	409
2003	2280	1458	275	367	415	532	781	188	364
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2010	2616	1794	257	280	446	466	301	201	274
2011	2347	1347	242	353	546	412	339	193	249
2012	3255	1804	386	268	410	427	260	129	226
2013	2491	1850	306	399	623	534	280	181	307
2014	2329	1743	256	289	817	499	224	187	271
2015	2054	1450	177	269	487	440	227	99	210
2016	2246	1452	166	174	463	501	140	109	180
2017	1202	554	154	111	336	385	90	62	115
2018	1140	528	97	91	302	402	44	89	156
2019	1361	544	89	77	352	347	48	39	141
Total per species since 1990	87,574	65,578	8,587	10,650	17,098	12,270	14,798	3,611	8,899