MOOSE TREND SURVEY SUMMARY 2021

Koyukuk/Nowitna/Innoko NWR Complex (Game Management Units 21A, 21B, 21D and 24D)

November 24, 2021
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We conducted aerial moose trend surveys on the Koyukuk/Nowitna/Innoko NWR from November 5-18, 2021. We completed four Trend Count Areas (TCAs) on the Koyukuk, one TCA on Innoko, two TCAs on the Nowitna, and three TCAs on the Kaiyuh (Northern Innoko). The State survey crew flew one TCA on the Koyukuk. Snow conditions this year were excellent (6"-8" on the ground) everywhere in all TCAs. Temperatures were mostly average (-22 to +25°F) throughout the survey. Sightability was good or excellent most days because of high overcast and adequate snow cover, though heavy frost created a "canopy" in dense brush and forested areas.

The population in the Pilot Mt/Galena/Koyukuk River Mouth area remains healthy, though we observed a second year of lower calf production. The number of cows and bulls remain stable and healthy, and yearling bulls are in the low range of what we would consider "average".

The Kaiyuh moose population (between Nulato and Kaltag) growth seems to be slowing or flattening out from the steady increase observed since 2011. Overall numbers of cows and bulls are still above the long-term average and yearling recruitment and calf production/survival to fall are good, but not as high as they had been a few years ago.

We recorded another low in the overall number of moose observed in the Nowitna River TCAs this survey season. Cow numbers were again below the long-term average. Overall bull numbers are better than last year's low, though still below average. Calf production also was better than last year, but remains on the low-average. Yearling bull recruitment remains well below average also. Overall, the continued lower observations on the Nowitna is concerning.

The Innoko River (between the lower Dishna and Grouch Creek) appears to be a healthy, low density population. This year we again saw a decrease in cows and bulls observed. Last year we recorded a staggering zero calves, which none of us had ever seen before on a survey. This year, calf numbers were back up to average, which was a relief. Yearling bull observations decreased again, which was not surprising given the lack of calves last year. The downward trend in this population is concerning, though it is a low density population and variations tend to swing widely in low density populations.

The northern Koyukuk (Treat Island and Huslia Flats) adult cow numbers have been inching back up to the long-term averages (800) in recent years, though observations decreased slightly this year and are just below the average. Calf production increased and is back up to the long-term average. Bulls are at the long-term average, though yearling bull numbers were low again and are below average (medium and large bulls are both above average). Considered separately, the Huslia Flats TCA has shown a consistent and stable adult population with annual variations in calf production, while Treat Island TCA seems to exhibit a similar stable bull population but shows a 20-year declining trend in cows. More moose than usual were observed in the Dulbi

Slough TCA to the south (between Treat Island/Huslia Flats TCAs and the Dulbi River TCA) while transitioning between TCA's, which may indicate movement and distribution changes in the area.

The middle Koyukuk (3-Day Slough and Dulbi River) saw decreases in both bull and cow numbers, which were finally inching back up to the long-term averages last year. Calf numbers were observed to be at the long-term average, while yearling bulls remain higher and just above average. While flying the northeastern edge of Dulbi River, we observed large numbers of moose just over the line and in the adjacent Dulbi Slough TCA, which was not surveyed this year. Again, movement and distribution of moose may contribute to the lower number of moose observed this year in the Dulbi River TCA

METHODS/SURVEY AREAS

The Alaska Department of Fish and Game surveyed the Three-Day Slough TCA on the Koyukuk NWR (21D). USFWS crews surveyed the Koyukuk River Mouth, Dulbi River Mouth, Huslia River Flats, Treat Island TCA's on the Koyukuk NWR (GMU 21D and 24D), Innoko River TCA on the Innoko NWR (GMU 21A), Kaiyuh Slough, Pilot Mt. Slough, and Squirrel Creek TCAs on the Northern Unit of Innoko NWR (Kaiyuh) (GMU 21D), and Nowitna River Mouth and Nowitna/Sulatna River Confluence TCA's on the Nowitna NWR (GMU 21B).

Units were surveyed using three CubCrafter Top-Cubs. Pilots utilized for trend count surveys this year were; B. Scotton, E. Mallek, and N. Guldager. Observers included; J. Bryant, B. Pratt, B. Nigus, and B. Rebarchik. Pilots used GPS location data to navigate the .25 mile transects and the observer recorded locations on a GPS and paper data sheets. Search intensity required is 7-8 minutes per square mile (or 38-44 minutes per unit), but varies depending on density of moose and habitat type (as little as 20 min. in open habitats and as much as 70 min. in closed habitats). The GSPE method does not specify a sightability correction factor as previously required by the Gasaway method. Research elsewhere in the state suggests that 10-25% of moose are not seen during this type of survey. Since these are a trend survey, methodology should be kept as consistent as possible so comparisons between years can be made directly. In normal snow years, search aircraft fly 9-12 transect lines per unit. Overall, we spent an average of 35.6 minutes per unit or 6.33 minutes per square mile surveying 242 units this year.

RESULTS

Koyukuk and Northern Unit of Innoko (Kaiyuh) NWRS:

Survey Timing and Conditions: We received good snow, consistent cool temperatures, and very little to no wind in mid October, followed by heavy frost in early November. We began surveys at Huslia Flats on November 5 with one airplane. Ed and Nikki (who came out to help again this year) flew out to Galena on the 8th and we had three planes surveying from the 9th until the 18th. We had the longest stretch of good weather and conditions ever during this year's surveys and were able to finish all TCAs by November 18 – which in some years is when we start flying. We did encounter a few instances of ice fog/mist at Huslia Flats, Novi Mouth, Kaiyuh, and Innoko, but we were able to move around and keep working. All the TCAs had good to excellent snow

cover and heavy frost in forested or shrubby areas. Snow depths were about 6-8 inches deep in most of the survey areas.

Treat Island and Hulsia Flats TCAs Combined, southern GMU 24:

These two combined TCAs cover a continuous area north/northeast of Huslia totaling 306 mi². Results from this year's 2021 surveys indicate that adult cow numbers are a little below what we've seen the last three years and are just below the long-term average while bull numbers are back up near the long-term average again this year. Calf production/survival to fall was higher than the last few years, and is average. The bull:cow ratio is above average at 41 bulls:100 cows (Table 1, Figs. 1, 2, & 3). Recruitment decreased in the last three years and is below average at 6 yearling bulls:100 cows. Snow conditions were good to excellent this year, though the number of cows and yearling bulls still declined, probably due to movement or the high snow levels last winter. We did not see a large decline in calf numbers, which is promising for next year's count. When the two TCAs are considered separately, Huslia Flats is performing much better than Treat Island. The two areas are adjacent to each other, but Huslia Flats shows consistent cow numbers, increasing bulls, and excellent calf production. Conversely, Treat Island has seen a steady decrease in moose density at an average annual rate of -7%. Calf production and yearling recruitment at Treat has also been consistently lower than at Huslia Flats. We do know that movement and distribution affect the annual counts in these TCAs, but the long-term trend appears to show a decline in overall density and productivity at Treat Island, relative to Huslia Flats.

Dulbi River Mouth and Three Day Slough TCAs Combined, GMU 21D:

The combined TCAs cover a discontinuous area (the two are not connected, but are within a few miles along the Koyukuk River south of Roundabout Mt.) totaling 277 mi². Total counts from this year's survey decreased from last year's improvements, though we still consider this area stable and slowly recovering from the decline observed in 2012. Cow and bull numbers have been inching back up to the long-term averages (Tables 2 & 3, Figs. 4, 5, & 6) and are finally both just above average again. Yearling bull observations were average for the second year and the yearling bull:cow ratio is good (above the long-term average at 9 yearling bulls/100 cows), but may be inflated some by the small decrease in cow observations. Calf numbers increased and calf production/ or survival of calves to fall (28 calves/100 cows) is excellent. The overall bull ratio is good for the second year at 28 bulls:cows, which is above the long-term average, due mainly to a slight decrease in cows coupled with a steady number of bulls in all three classification of yearling, medium, and large bulls observed. Snow conditions at 3-Day Slough and Dulbi River were excellent with heavy frost this year. We did observe large groups of moose in units just outside of the TCA's this year, including bull aggregates, indicating that movement and distribution in and out of the trend count areas affect annual observation totals.

Koyukuk River Mouth, Pilot Mountain, and Squirrel Creek TCAs Combined, GMU 21D:

The combined TCAs cover a continuous area totaling 307 mi² between the villages of Galena and Koyukuk on the south side of the Yukon River and a section on the north side of the Yukon at the mouth of the Koyukuk River. These trend count areas continued to remain healthy though

beginning to level off from the steady growth from 2014-2017. Cows are just above the long-term average and calf production (or survival to fall) is below 40 for only the second time since 2013 at 27 calves per 100 cows (Table 4, Figs. 7, 8, & 9). Recruitment of yearling bulls has been steadily coming down (from the highs seen from 2015-2019) and is below average at 5 yearling bulls:100 cows this year. The bull:cow ratio is average at 25 bulls per 100 cows. Snow conditions were excellent with heavy frost. The Pilot Mt. and Koyukuk Mouth TCAs in this area are heavily hunted with good fall hunting access.

Kaiyuh Slough TCA:

Kaiyuh Slough is a medium density (lower density away from the river) moose population TCA along the south side of the Yukon River between Nulato and Kaltag totaling 217 mi^2.

All age/sex classes of the Kaiyuh TCA population continue to stay above the long-term average this year and appear to have leveled off in the last two years (Table 5, Figs. 11, 12, & 13) at a healthy higher density. The number of cows remained stable for the past five years at a level above the long-term average. Calf numbers have been at a lower productivity rate for the past four years, thus calf production (or survival to fall) remains below average (though good) at 27 calves per 100 cows. The number of yearling bulls isaverage with a ratio of 7 yearling bulls:100 cows. The overall bull:cow ratio is just below average for this area at 40 bulls per 100 cows. This trend area historically exhibited high variability from year to year due to low moose density, dense spruce/low sightability in some areas and movement issues along the river edges and islands. The Kaiyuh recently experienced several years of steady growth supported by high levels of recruitment and calf survival but appears to be slowing down and/or levelling off.

NOWITNA NWR:

Survey Timing and Conditions: Surveys began on November 10th and were finished up on the 12th. Snow conditions on the Nowitna were excellent, though we did encounter some heavy frost in the trees and had one day of icy mist to contend with. Overall, conditions were excellent this year.

Lower Nowitna River Combined, GMU 21B:

Results from the combined trend count areas extending from the Little Mud River down to the Nowitna River mouth (Nowitna/Sulatna Confluence and Nowitna Mouth TCAs) indicate another decrease (Table 6 & Figs. 14, 15, & 16). The number of cows fluctuates up and down fairly regularly over the years and may be most influenced by yearling cow recruitment. This year the number of cows decreased again and remains below the long-term average. The overall bull numbers increased from the low observed last year, though is still below average. Because cows decreased this year, the bull:cow ratio is 30 bulls/100 cows. The yearling bull recruitment is down to just 4 yearling bulls:100 cows. Calf production increased from last year to 35 calves:100 cows this year. These results, along with the lower numbers seen in the last few years, are concerning.

INNOKO NWR:

Survey Timing and Conditions: We surveyed the Innoko trend area on the 13th with two Topcubs and finished with one plane on the 17th. Snow conditions were good, though we did have to deal with heavy frost on the underbrush and trees and some icy mist/fog. Low ceilings and light snow delayed the completion of the TCA until the 17th (couldn't get over the hills).

Innoko River, GMU 21A:

Innoko TCA is a medium/low density (much lower density away from the river) moose population along the Innoko River from the Lower Dishna River mouth down to Grouch Creek, totaling 122 mi². This is a newer TCA and has been surveyed annually since 2011. Results from the 2021 surveys show the second year of lower adult cow and bull numbers (Tables 8, Figs. 17, 18, & 19). The bull:cow ratio fell to 28 bulls:100 cows, the majority of which are medium and large bulls. Calf production (survival to fall) recovered to 49 calves:100 cows, though was inflated by a decrease in overall cow observations. Last year, we did not observe a single calf during the survey and consequently this year's yearling recruitment was far below average at 1 yearling bulls per 100 cows. Though we only have ten years of data so far, the population has been healthy and appeared to be growing until last year, supported by the good levels of recruitment and calf survival. Winter snow levels in the last two years were high and may have affected survival.

DISCUSSION

Nowitna NWR (GMU 21B):

Over the long term, the Nowitna moose population had been fairly stable at a low density. Trend count areas in the river corridor portion of the unit indicate cow numbers have declined in recent years and are well below average. Bull abundance is also down, but ratios are healthy overall. Calf production/survival to fall improved this year from a relatively poor year in 2020 and should be considered average. Nothing about the Nowitna survey results promotes great optimism. Surveys from 2019 in the Deep Creek TCA also show lower moose abundance from the previous two counts (2001 & 2008) and were about half of what was counted previously. Hunting pressure along the river corridor remains consistent, though the checkstation was not operated in 2020 due to covid, but we suspect there were fewer hunters than average. The bull:cow ratio in other portions of GMU 21B, where hunting pressure is lower (away from the river corridors), is undoubtedly higher. A continued conservative harvest strategy for this area is warranted due to the overall low performance of the population, fluctuating cow numbers in the TCAs, and the low bull cow ratio (which as not consistently stayed above 25 since prior to 2015). Bull to cow ratios remain adequate for breeding, but we will be keeping a close eye on cow abundance in these trend areas. The long-term trend is poor overall, but it is possible that moose have shifted their usage of habitat to include more of the area burned in 2015. In fact, the only optimism is in the hope that the large burns from 2015 will eventually contribute to better productivity in the population. If we observe another year of poor data from trend surveys next fall, we will consider a population estimate in a portion of the area. Recommendation: No additional hunting opportunities are warranted at this time.

Innoko NWR (GMU 21A)

This population appears to have been increasing and doing quite well since the inception of our survey in 2011. The complete absence of calves last year was striking. Calf numbers rebounded this year and reasonable number were located during the survey. Adult numbers were lower this year, and it's possible that two severe winters in a row had a detrimental effect on this population. The weak or absent cohort may not affect the population dramatically if production remains normal for several years. This is a moderate to low density area and only a small section (122 miles) of the long river corridor is surveyed. The lower bull numbers might be an indication that the level of hunting along the river corridor is not sustainable with the current level of productivity. With only 23 bulls observed and the bull to cow ratio down to 28 per 100 (from 83 bulls per 100 cows), we need to closely monitor this population. Snow levels were lower during this survey, which can affect distribution, so it is also possible that moose were just more widely scattered this fall. We will be monitoring this population closely next November.

Koyukuk/Northern Innoko NWR (GMU 21D and Southern GMU 24):

When all TCAs on the southern Koyukuk and Northern Innoko (Kaiyuh) (181 GSPE units totaling 1,016 mi^2) are considered together, this population has had an amazingly stable adult population for many years (Table 9, Figs. 23, 24, & 25).

The northern Koyukuk TCAs (Huslia Flats and Treat Island) overall cow and bull count is back up to or very near the long-term average. Survey snow conditions were good, though not deep, at Treat Island and in Huslia Flats in 2021. We saw a somewhat lower cow number, and similar bull numbers compared to those observed last year. Calf numbers improved and were higher than the last 3 years. We are cautiously optimistic that this population has mostly recovered from the large decline observed in 2012. Three years of good calf production in 2015-2017 helped provide recruitment of younger cows into the breeding population. The overall bull population is at the long-term average. The overall production and recruitment rates were lower in 2019 and 2020, at just 16 calves/100 cows and 21 calves/100 cows. Calves were up this year, and we observed 33 calves per 100 cows. Deep snow the last two winters and extensive flooding along the Koyukuk for two summers may have adversely affected calf and yearling survival somewhat, but considering these negatives, the population appears to being doing pretty well, probably because of its younger overall age structure.

The overall population in GMU24D has improved and may have stabilized but lower average production and recruitment for the last 4 years has not promoted robust growth either. We should remain mindful of our harvest strategies for another year. Recommendation: We recommend the cancellation of the GMU 24D winter moose hunt as a conservative strategy. By foregoing any cow harvest right now, we can promote natural growth in the population to a higher level. Densities of moose overall are still high when compared with much of interior Alaska and hunting success rates in the fall have been high. The deep snow winters of the last two years probably slowed population growth, but a mild winter and continued growth could change the need for this conservative harvest strategy in future years.

Things are starting to look better with adult bull and cow numbers in the middle Koyukuk TCAs (Dulbi River and Three-Day Slough). Steady bull numbers and improved calf numbers in this area provide reasons for optimism. We counted just under 200 calves this year, which is better than the last 3 years. Movement in and out of these trend areas is extensive, and we observed large groups of moose just outside the edge units of Dulbi River this year. These trend areas are the most heavily hunted TCA's of the eight on the Koyukuk/Kaiyuh and they also have had the poorest productivity and recruitment in recent years. Hunting pressure is consistently high and contributes to the average bull cow ratios (around 27 per 100 cows) that we regularly observe. Overall, numbers in the 3-Day slough trend areas were better than those seen in Dulbi River, however we suspect that movement and distribution played a role in the lower numbers seen in Duli River.

In GMU21D North of the Yukon River, the recent poor recruitment of bulls into the population and subsequent low bull:cow ratios in heavily hunted areas, has been a concern. Slightly improved cow abundance is another positive sign. The low calf:cow ratio in this area, particularly, 3-Day Slough and Dulbi River seems chronic after the previous 3 years but did improve somewhat this year. Recommendation: No winter seasons are recommended for this area.

The population in the Pilot Mountain/Squirrel Creek, and Koyukuk Mouth TCA's has been doing extremely well for several years. This year, the bulls were up, cows were stable, and calf numbers were similar to last year. Since we had a pretty deep snow winter last year, and our age structure is young, this scenario is not unexpected. This population is robust and can support significant harvest.

The Kaiyuh Slough TCA count was back up from lower numbers observed last year. We suspect movement plays a big role in this TCA. Cows and bulls are near all-time highs and a similar number of calves was observed when compared to last year. This area has seen marked increases for several years, and the overall population on the Northern Unit of the Inoko Refuge (Kaiyuh) is very healthy and can sustain substantial harvest.

Both the southern Koyukuk and Kaiyuh Trend Areas continue to do very well, with a stable and possibly still increasing adult population, excellent calf production, good recruitment, and good bull to cow ratios. The population on the Kaiyuh may have paused its increasing trend but can still support some additional harvest. Bull:Cow ratios are lower in the Galena/Pilot Mtn. and Squirrel creek areas, but winter hunts on a small proportion (<1%) of the cow population can be supported. Complicated land status in these areas make Federal only seasons problematic. The new State registration hunt for this area should be an effective tool to allow a small, regulated harvest. Most recently, this hunt occurred during March 2019-2021 with 19 permits issued in 2019 (8 moose harvested), and 34 permits issued in 2020 (14 moose harvested), and 16 permits in 2021 (8 moose harvested) with a quota of 30 each year. Recommendation: This opportunity should be continued given the current population status.

Table1. Combined TCAs, Huslia Flats and Treat Island, 2001-2021 GSPE Summary, Koyukuk NWR, Alaska. *Very low snow during survey.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/100 cows	Calves/100 cows	Yrlg bulls/100 cows	Total moose/mi^2	Total cow moose/mi^2
Huslia/Treat	2001	260	889	110	1259	51	29	12	6	4.11	2.91
Huslia/Treat	2003	274	889	217	1380	85	31	24	10	4.51	2.91
Huslia/Treat	2004	308	929	296	1533	102	33	32	11	5.01	3.04
Huslia/Treat	2005	252	895	171	1318	103	28	19	12	4.31	2.92
Huslia/Treat	2006	341	906	304	1551	93	38	34	10	5.07	2.96
Huslia/Treat	2007	290	870	235	1395	100	33	27	12	4.56	2.84
Huslia/Treat	2008	251	798	184	1233	95	31	23	12	4.03	2.61
Huslia/Treat	2009	316	927	138	1381	112	34	15	12	4.51	3.03
Huslia/Treat	2010	291	807	201	1299	61	36	25	8	4.25	2.64
Huslia/Treat	2011	296	798	165	1259	81	37	21	10	4.11	2.61
Huslia/Treat	2012*	153	552	57	762	25	28	10	5	2.49	1.80
Huslia/Treat	2013	192	668	138	998	31	29	21	5	3.26	2.18
Huslia/Treat	2014*	214	548	95	857	47	39	17	9	2.80	1.79
Huslia/Treat	2015	233	698	250	1181	64	33	36	9	3.86	2.28
Huslia/Treat	2016*	183	534	165	882	51	34	31	10	2.88	1.75
Huslia/Treat	2017	249	770	244	1264	89	32	32	12	4.13	2.52
Huslia/Treat	2018*	318	783	171	1243	106	41	22	14	4.06	2.56
Huslia/Treat	2019	274	751	118	1143	54	37	16	7	3.74	2.45
Huslia/Treat	2020	276	712	147	1135	40	39	21	6	3.71	2.33
Huslia/Treat	2021	250	613	199	1065	37	41	33	6	3.48	2.00

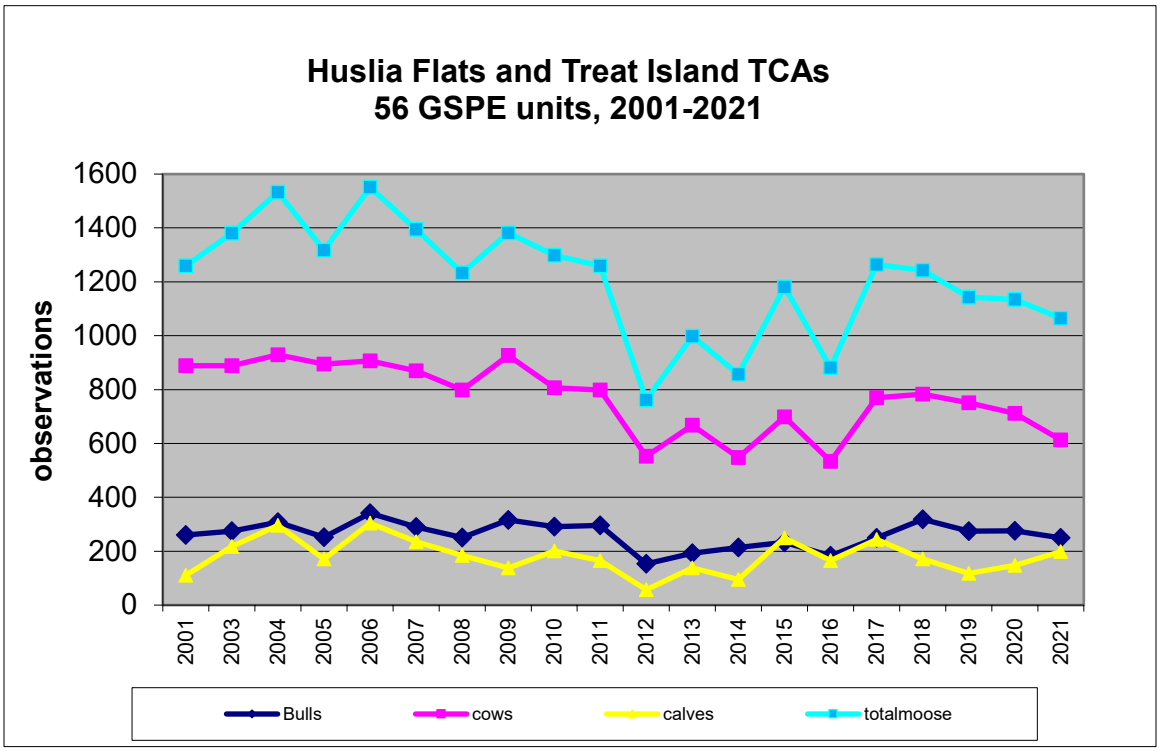

Figure 1. Huslia Flats and Treat Island observations, combined TCAs, GSPE 2001-2021, Koyukuk NWR, Alaska.

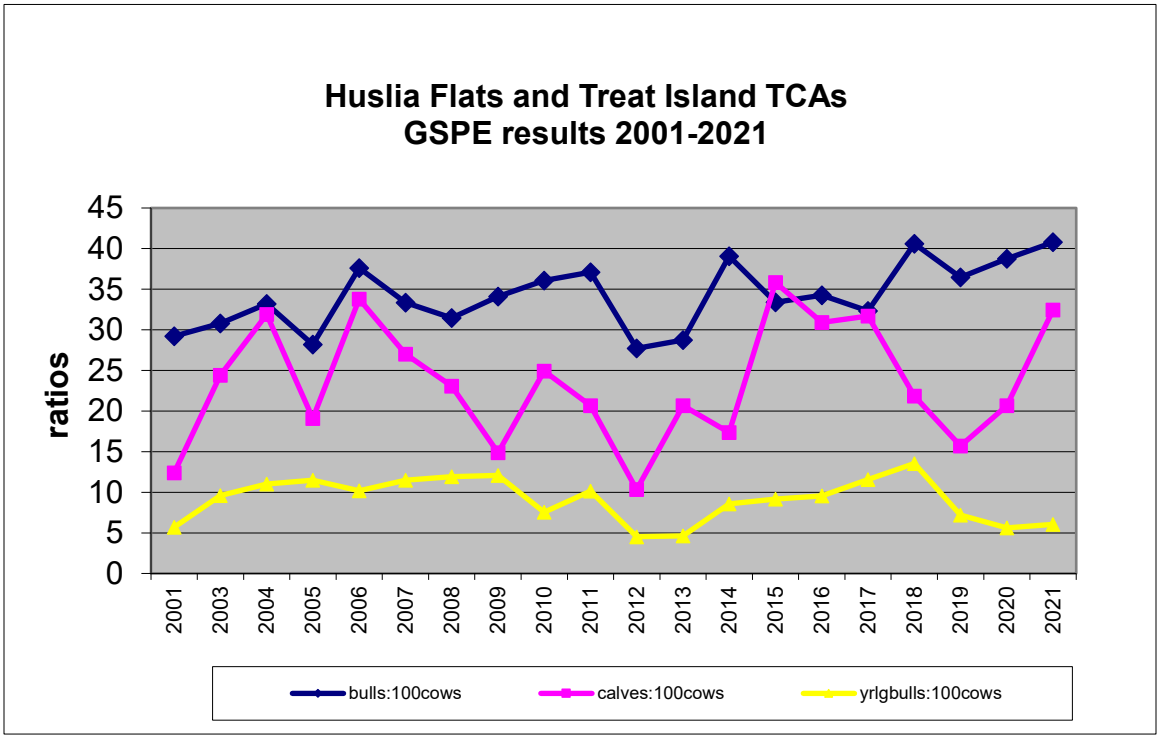

Figure 2. Huslia Flats and Treat Island ratios, combined TCAs, GSPE 2001-2021, Koyukuk NWR, Alaska

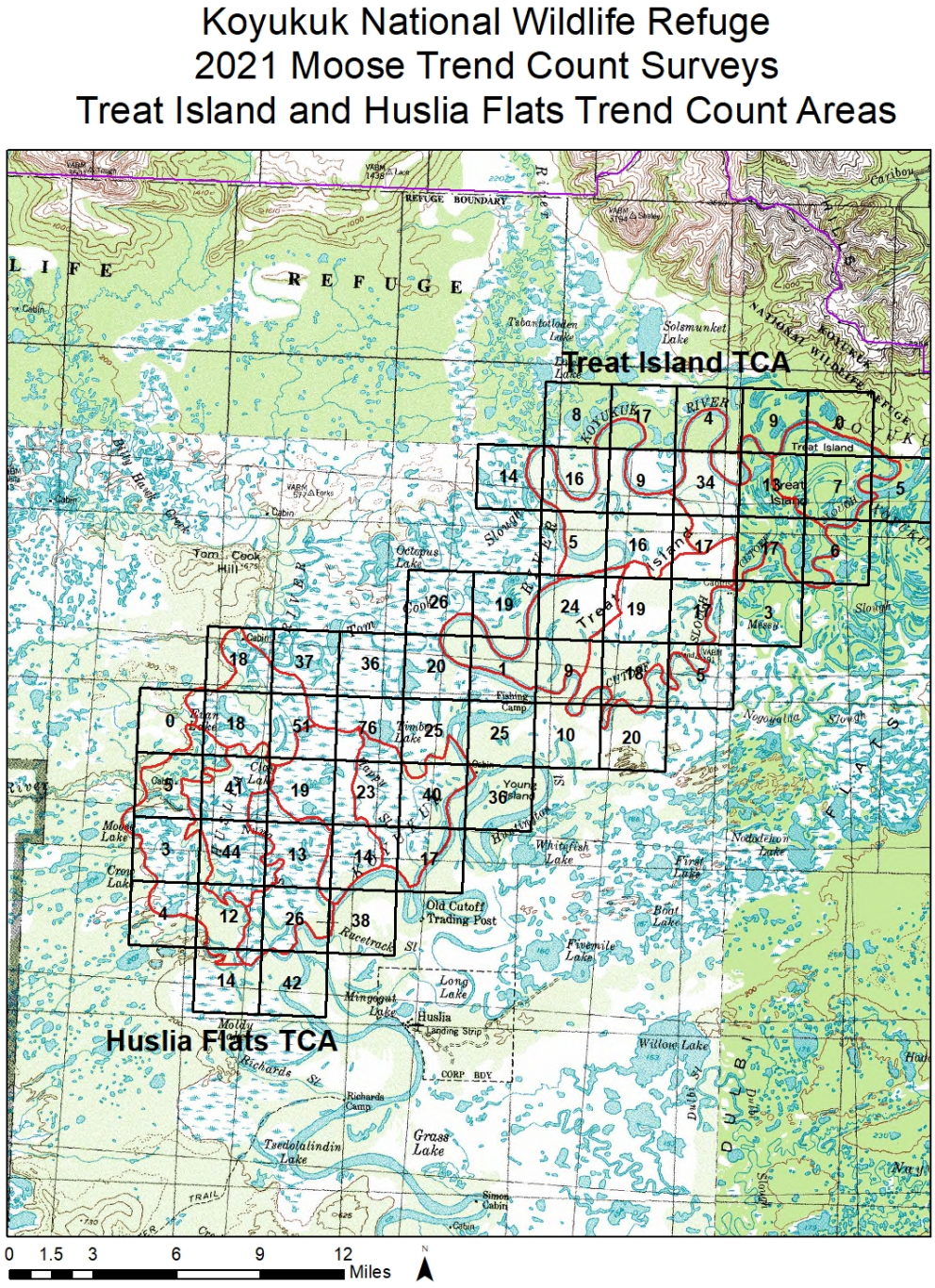

Figure 3. Huslia River and Treat Island TCA 2021, Koyukuk NWR, Alaska.

Table 2. Dulbi River , 2001-2021 GSPE Summary, Koyukuk NWR, Alaska. *Low snow during survey.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	yrlg bulls	Bulls/100 cows	Calves/100cow	Ylg bulls/100 cows	Tot cows w/tw	Tot cows w/clv	Twinning rate
Dulbi	2001	53	250	38	341	14	21	15	6	1	37	3
Dulbi	2003	49	294	68	411	19	17	23	7	3	65	5
Dulbi	2004	53	252	101	406	14	21	40	6	7	94	7
Dulbi	2005	42	237	54	333	19	18	23	8	2	52	4
Dulbi	2006	62	258	90	410	16	24	35	6	6	77	8
Dulbi	2007	90	248	116	454	31	36	47	13	11	102	11
Dulbi	2008	100	308	97	505	38	33	32	12	5	92	5
Dulbi	2009	127	350	57	534	37	39	18	12	3	54	6
Dulbi	2010	65	266	83	414	4	24	31	2	6	72	8
Dulbi	2011	78	330	96	504	23	24	29	7	3	92	3
Dulbi	2012*	59	231	40	330	12	26	17	5	0	40	0
Dulbi	2013	64	260	35	359	19	25	14	7	0	35	0
Dulbi	2014*	49	124	35	208	13	40	28	11	0	35	0
Dulbi	2015	55	268	127	451	15	21	47	6	15	107	15
Dulbi	2016*	71	226	87	384	48	31	38	21	8	79	10
Dulbi	2017	83	237	73	393	31	35	31	13	2	71	3
Dulbi	2018*	47	199	55	301	11	24	28	6	3	52	6
Dulbi	2019	52	203	43	298	7	26	21	4	3	40	8
Dulbi	2020	71	261	57	389	16	27	22	6	4	52	8
Dulbi	2021	47	186	55	288	8	26	26	5	8	51	4

Three-Day Slough, 2001-2021 GSPE Summary, Koyukuk NWR, Alaska.

3-Day	2001	125	612	79	816	35	20	13	6	1	80	1
3-Day	2003	106	610	130	846	43	17	21	7	9	121	7
3-Day	2004	130	568	128	826	52	23	23	9	7	120	6
3-Day	2005	114	506	107	727	28	23	21	6	7	100	7
3-Day	2006	162	643	258	1063	43	25	40	7	32	225	14
3-Day	2007	160	484	154	798	50	33	32	10	11	143	8
3-Day	2008	222	773	145	1140	60	29	19	8	8	137	6
3-Day	2009	190	729	83	1002	56	26	11	8	2	81	3
3-Day	2010	198	640	168	1006	29	25	23	7	6	162	4
3-Day	2011	174	514	114	802	64	34	22	12	5	109	5
3-Day	2012*	119	428	45	592	24	28	11	6	1	43	2
3-Day	2013	116	497	78	691	20	23	16	4	3	75	4
3-Day	2014*	118	450	75	643	37	26	17	8	3	72	4
3-Day	2015	91	430	155	676	36	21	36	8	13	142	13
3-Day	2016*	122	498	147	767	49	25	30	10	10	136	7
3-Day	2017	108	566	153	827	45	19	27	8	10	143	7
3-Day	2018	105	582	82	769	42	18	14	7	4	78	6
3-Day	2019	113	567	120	800	21	20	21	4	3	117	3
3-Day	2020	157	568	109	834	44	28	19	8	5	104	5
3-Day	2021	146	515	143	804	53	28	28	10	11	131	8

Table 3. Combined TCAs, Dulbi River and Three-Day Slough, 2001-2021 GSPE Summary, Koyukuk NWR, Alaska. *Very low snow during survey.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/100 cows	Calves/100 cows	Yrlg bulls/100 cows	Twins/100 cows w/calves	Total moose/mi^2	Total cow moose/mi^2
Dulbi/3Day	2001	178	862	117	1157	49	21	14	6	2	4.18	3.11
Dulbi/3Day	2003	155	904	198	1257	62	17	22	7	7	4.54	3.26
Dulbi/3Day	2004	183	820	229	1232	66	22	28	8	7	4.45	2.96
Dulbi/3Day	2005	156	743	161	1060	47	21	22	6	6	3.83	2.68
Dulbi/3Day	2006	224	901	341	1466	59	25	38	7	13	5.29	3.25
Dulbi/3Day	2007	250	732	270	1252	81	34	37	11	9	4.51	2.64
Dulbi/3Day	2008	322	1081	242	1645	98	30	22	9	6	5.94	3.90
Dulbi/3Day	2009	317	1079	140	1536	93	29	13	9	4	5.55	3.90
Dulbi/3Day	2010	236	906	251	1420	33	29	28	4	5	5.13	3.27
Dulbi/3Day	2011	252	844	210	1306	87	30	25	10	4	4.71	3.05
Dulbi/3Day	2012*	178	659	85	922	36	27	13	6	1	3.33	2.38
Dulbi/3Day	2013	180	757	113	1050	39	24	15	5	3	3.79	2.73
Dulbi/3Day	2014*	167	574	110	851	50	29	19	9	3	2.90	1.94
Dulbi/3Day	2015	146	698	282	1126	51	21	40	7	11	4.04	2.49
Dulbi/3Day	2016*	193	724	234	1151	97	27	32	13	9	4.16	2.61
Dulbi/3Day	2017	191	803	226	1220	76	24	28	10	6	4.40	2.89
Dulbi/3Day	2018*	152	781	137	1070	53	19	18	7	6	3.86	2.82
Dulbi/3Day	2019	165	770	163	1078	28	21	21	4	4	3.89	2.78
Dulbi/3Day	2020	228	829	166	1223	60	28	20	7	6	4.42	2.99
Dulbi/3Day	2021	193	701	198	1092	61	28	28	9	8	3.94	2.53

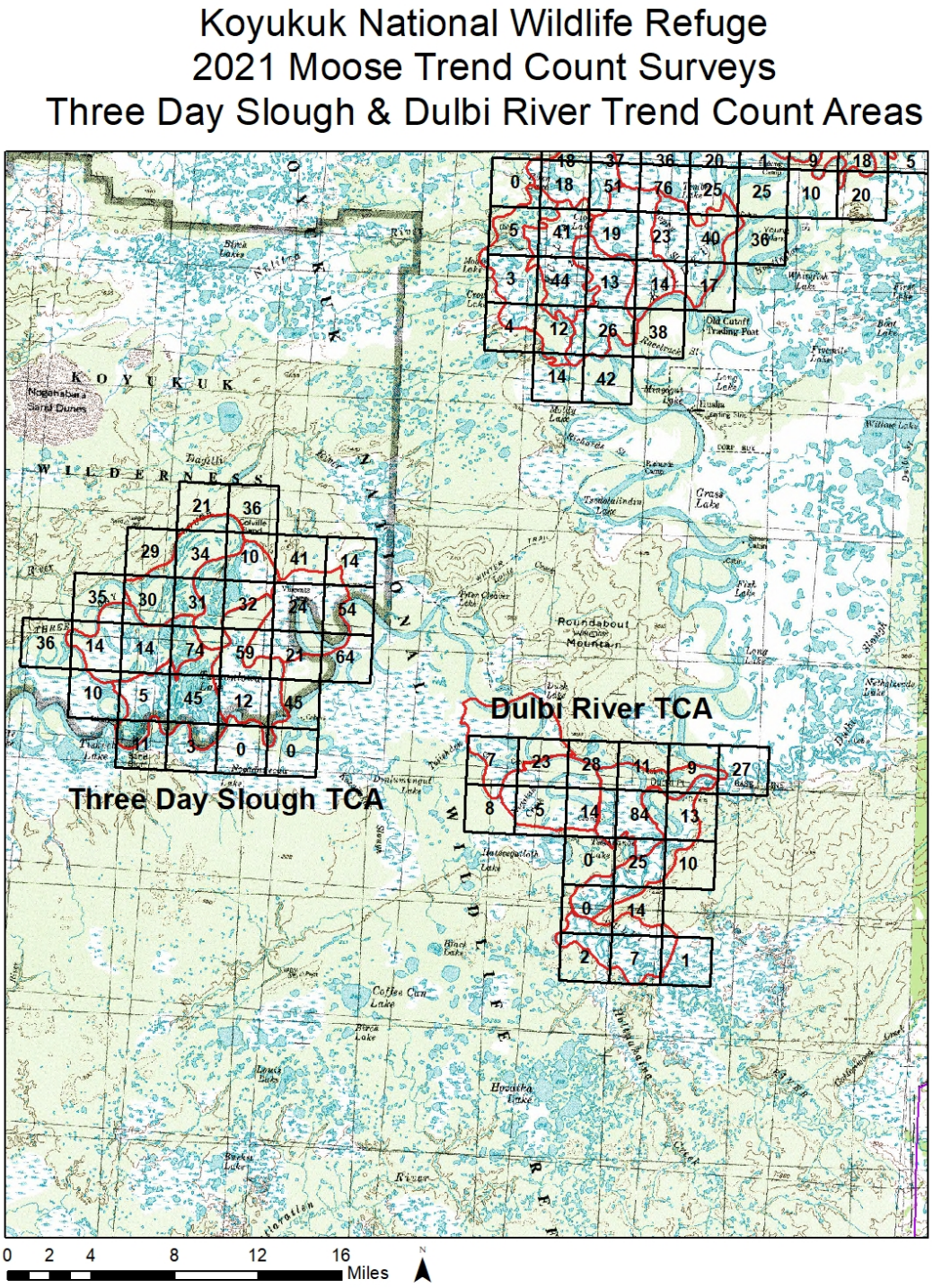

Figure 4. Three-Day Slough and Dulbi River TCA moose observations 2021, Koyukuk NWR, Alaska.

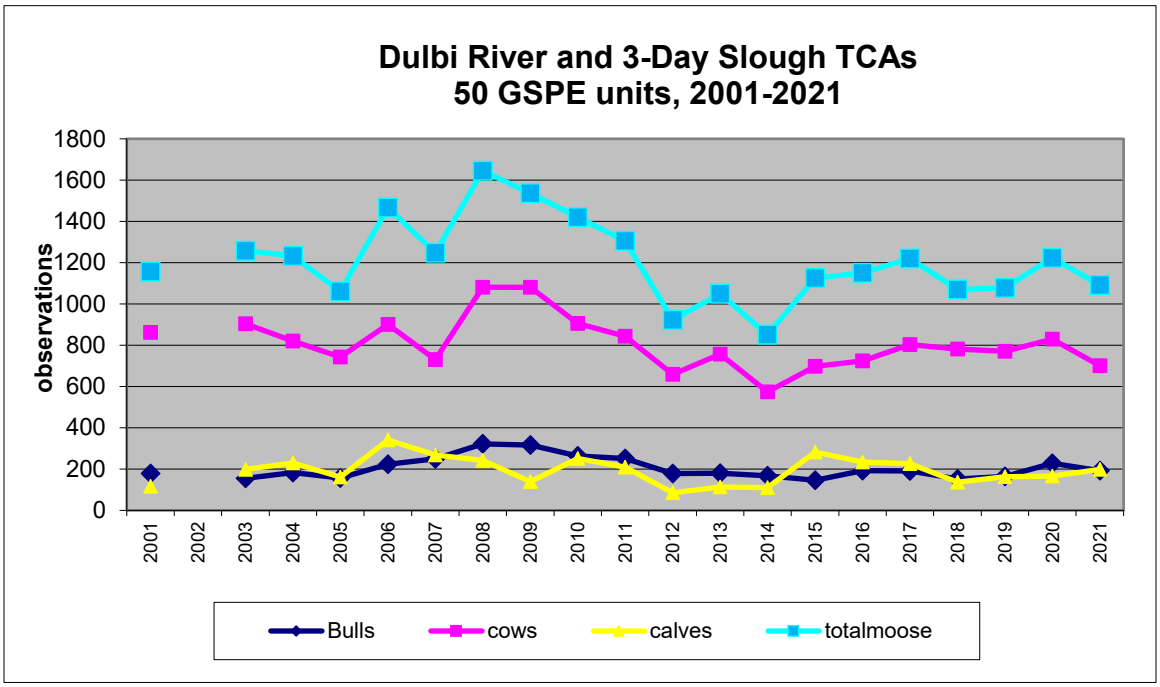

Figure 5. Dulbi River and 3Day Slough observations, combined TCAs, GSPE 2001-2021, Koyukuk NWR, Alaska.

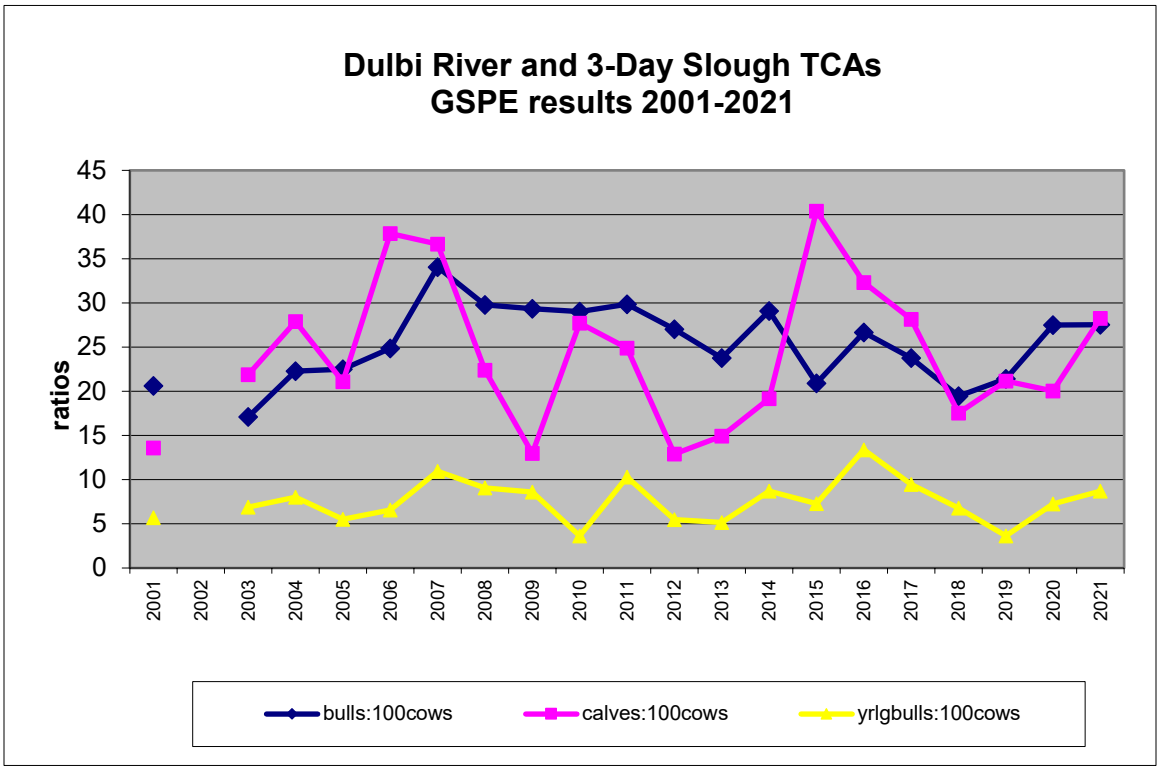

Figure 6. Dulbi River and 3Day Slough ratios, combined TCAs, GSPE 2001-2021, Koyukuk NWR, Alaska.

Table 4. Combined TCAs, Koyukuk River Mouth, Pilot Mt. Slough, and Squirrel Creek, 2001-2021 GSPE Summary, Koyukuk NWR, Alaska.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/100 cows	Calves/100 cows	Yrlg bulls/100 cows	Twins/100 cows w/calves	Total moose/mi^2	Total cow moose/mi^2
Galena/Koyukuk	2001	234	687	136	1057	51	34	20	7	2	3.44	2.24
Galena/Koyukuk	2002	179	583	260	1022	33	31	46	6	10	3.33	1.90
Galena/Koyukuk	2003	159	693	253	1105	69	23	37	10	10	3.60	2.26
Galena/Koyukuk	2004	185	684	301	1170	75	27	44	11	11	3.81	2.23
Galena/Koyukuk	2005	152	623	238	1013	51	24	38	8	9	3.30	2.03
Galena/Koyukuk	2006	136	634	180	950	44	22	28	7	10	3.09	2.07
Galena/Koyukuk	2007	174	717	290	1181	66	24	41	9	10	3.85	2.34
Galena/Koyukuk	2008	183	641	202	1026	76	29	32	12	7	3.34	2.09
Galena/Koyukuk	2009	197	774	130	1101	74	25	17	10	2	3.58	2.52
Galena/Koyukuk	2010	167	784	296	1247	24	21	38	3	7	4.06	2.55
Galena/Koyukuk	2011	175	866	276	1317	60	20	32	7	7	4.06	2.55
Galena/Koyukuk	2012	181	744	280	1205	54	24	38	7	6	3.93	2.42
Galena/Koyukuk	2013	196	773	148	1117	69	25	19	9	2	3.64	2.52
Galena/Koyukuk	2014	165	701	306	1172	50	24	44	7	14	3.82	2.28
Galena/Koyukuk	2015	230	934	481	1645	117	25	52	13	15	5.36	3.04
Galena/Koyukuk	2016	232	916	378	1526	110	25	41	12	11	4.97	2.98
Galena/Koyukuk	2017	222	1089	535	1829	88	20	49	8	14	5.96	3.55
Galena/Koyukuk	2018	196	1019	417	1632	92	19	41	9	12	5.32	3.32
Galena/Koyukuk	2019	233	941	382	1555	80	25	41	9	7	5.07	3.07
Galena/Koyukuk	2020	184	985	287	1456	58	19	29	6	4	4.74	3.21
Galena/Koyukuk	2021	236	961	263	1460	52	25	27	5	3	4.76	3.13

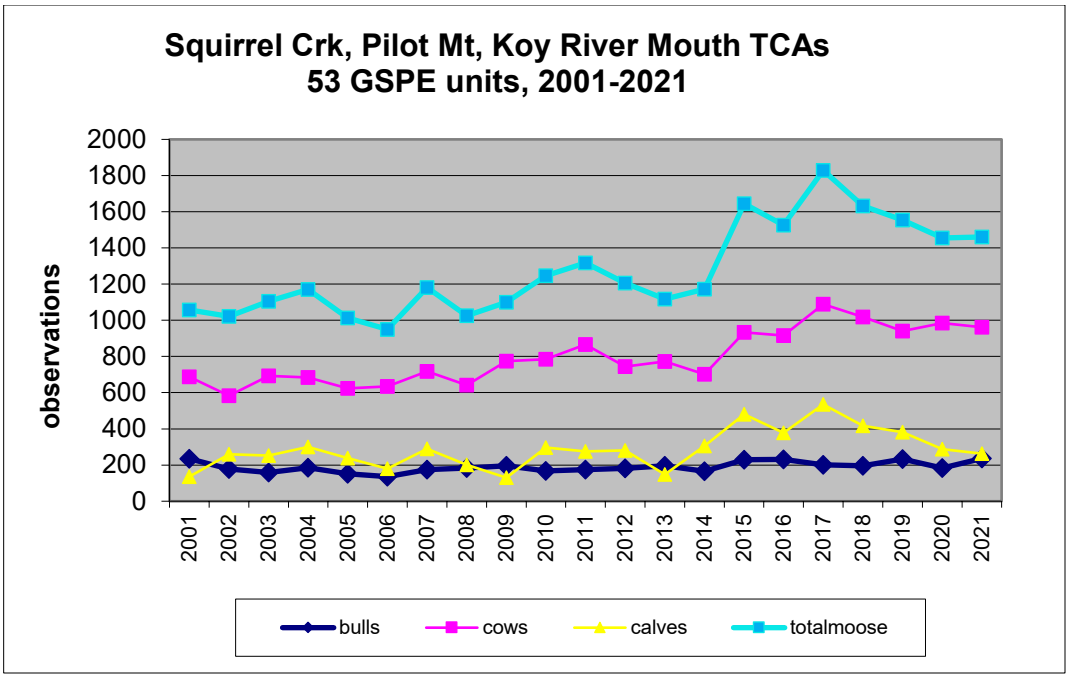

Figure 7. Squirrel Ck, Pilot Mt, Koyukuk Riv Mth observations, combined TCAs, GSPE 2001-2021, Koyukuk and Kaiyuh, Alaska.

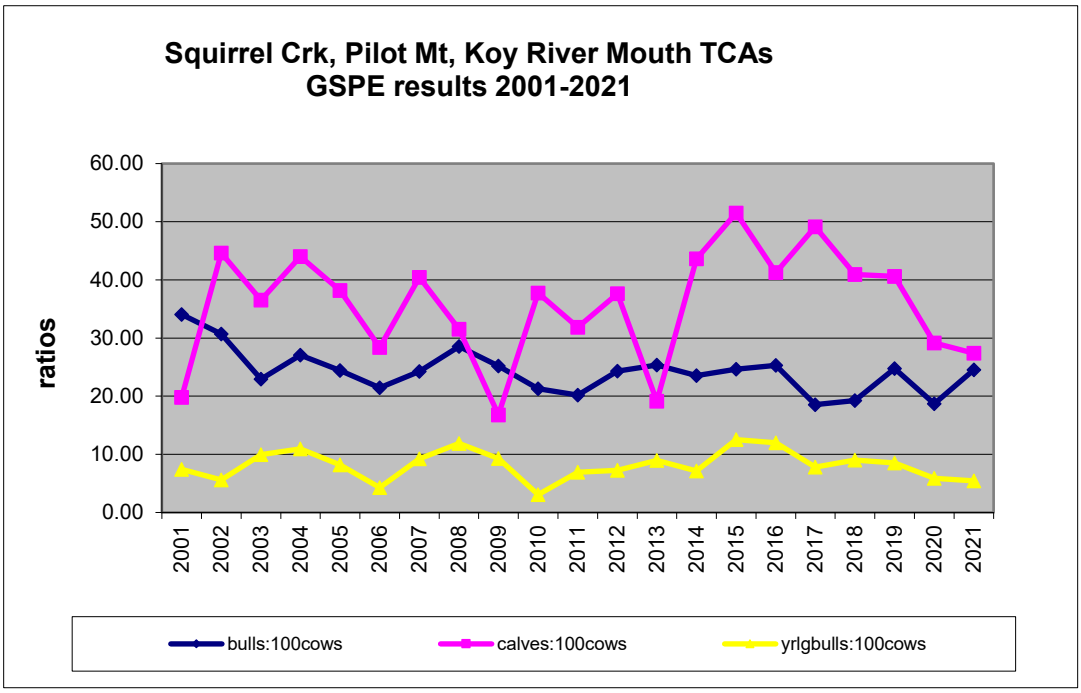

Figure 8. Squirrel Ck, Pilot Mt, Koyukuk Rv Mth combined ratios, GSPE 2001-2021, Koyukuk and Kaiyuh, Alaska.

Koyukuk National Wildlife Refuge
2021 Moose Trend Count Surveys
Koyukuk Mouth, Pilot Mt., & Squirrel Creek TCAs

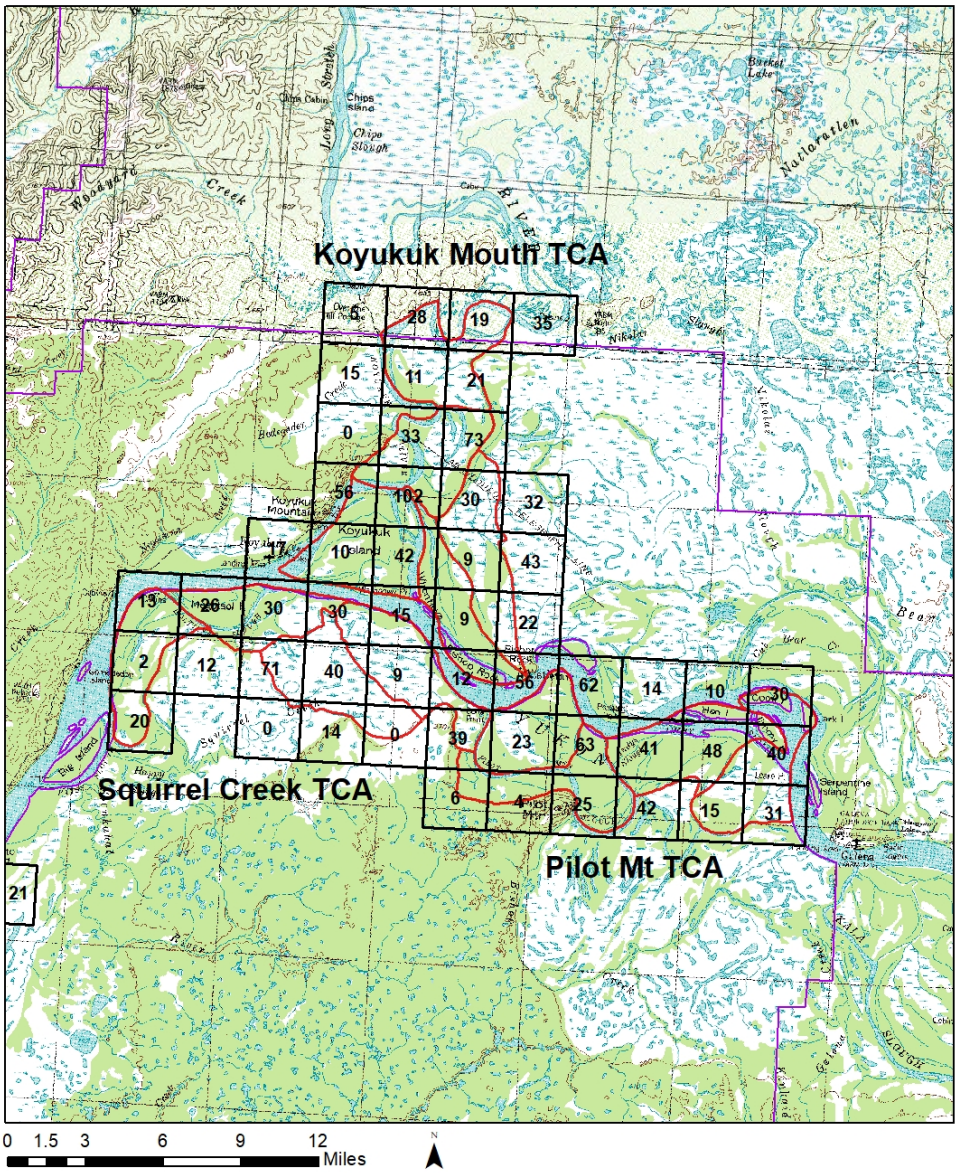

Figure 9. Pilot Mt, Squirrel Crk, and Koyukuk Mouth TCAs 2021, Koyukuk NWR, Alaska.

Table 5. Kaiyuh Slough, 2001-2021 GSPE Summary, Northern Unit of Innoko NWR, Alaska.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/ 100 cows	Calves/ 100 cows	Yrlg bulls/100 cows	Twins/ 100 cows w/calves	Total moose /mi^2	Total cow moose /mi^2
Kaiyuh	2001	57	83	8	148	5	69	10	6	0	1.17	0.66
Kaiyuh	2003	58	106	40	204	20	55	38	19	14	1.62	0.84
Kaiyuh	2004	64	111	59	234	21	58	53	19	26	1.86	0.88
Kaiyuh	2005	56	81	23	160	15	69	28	19	0	1.27	0.64
Kaiyuh	2006	44	105	22	171	5	42	21	5	5	1.36	0.83
Kaiyuh	2007	50	110	30	190	8	45	27	7	7	1.51	0.87
Kaiyuh	2008	39	66	31	136	5	59	47	8	19	1.08	0.52
Kaiyuh	2009	56	113	11	180	14	50	10	12	0	1.43	0.90
Kaiyuh	2010	43	97	47	187	11	44	49	11	9	1.48	0.77
Kaiyuh	2011	58	130	73	261	25	45	56	19	20	2.07	1.03
Kaiyuh	2012	76	157	76	309	25	48	48	16	15	2.45	1.25
Kaiyuh	2013	72	141	61	274	27	51	43	19	18	2.17	1.12
Kaiyuh	2014	61	101	70	232	15	60	69	15	17	1.84	0.80
Kaiyuh	2015	99	195	125	419	40	51	64	21	21	3.33	1.55
Kaiyuh	2016	91	170	88	349	29	54	52	17	19	2.76	1.35
Kaiyuh	2017	105	258	116	479	38	41	45	15	22	3.80	2.05
Kaiyuh	2018	94	251	77	422	25	38	31	10	9	3.35	1.99
Kaiyuh	2019	136	280	77	493	23	49	28	8	12	3.91	2.22
Kaiyuh	2020	93	204	72	369	10	46	35	5	3	2.93	1.62
Kaiyuh	2021	110	275	74	459	19	40	27	7	4	3.64	2.18

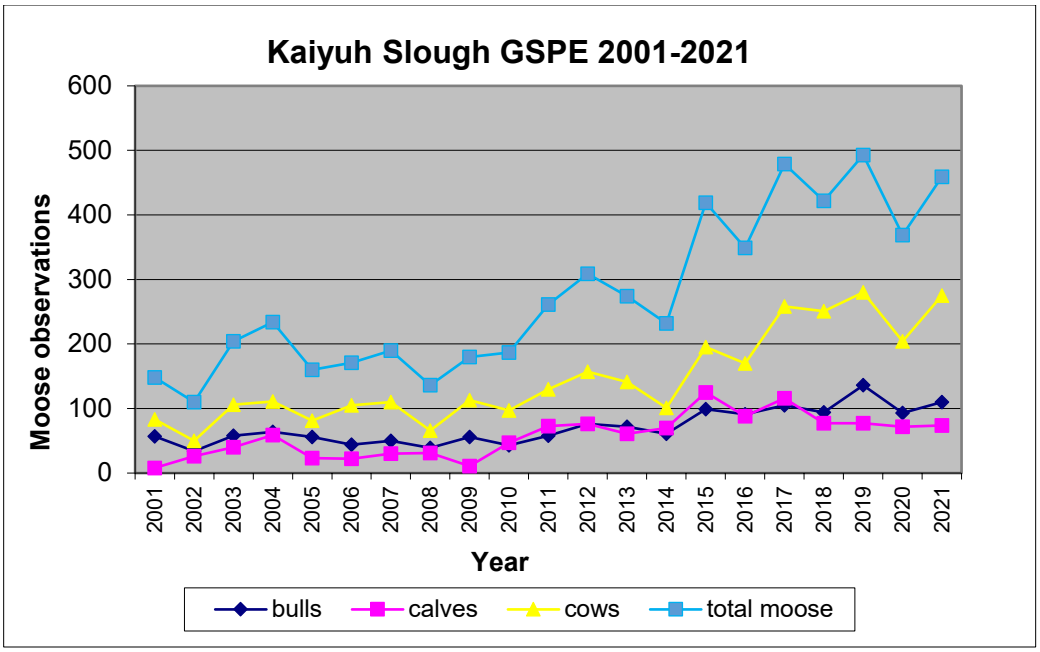

Figure 11. Kaiyuh Slough TCA observations, GSPE 2001-2021, Kaiyuh, Alaska.

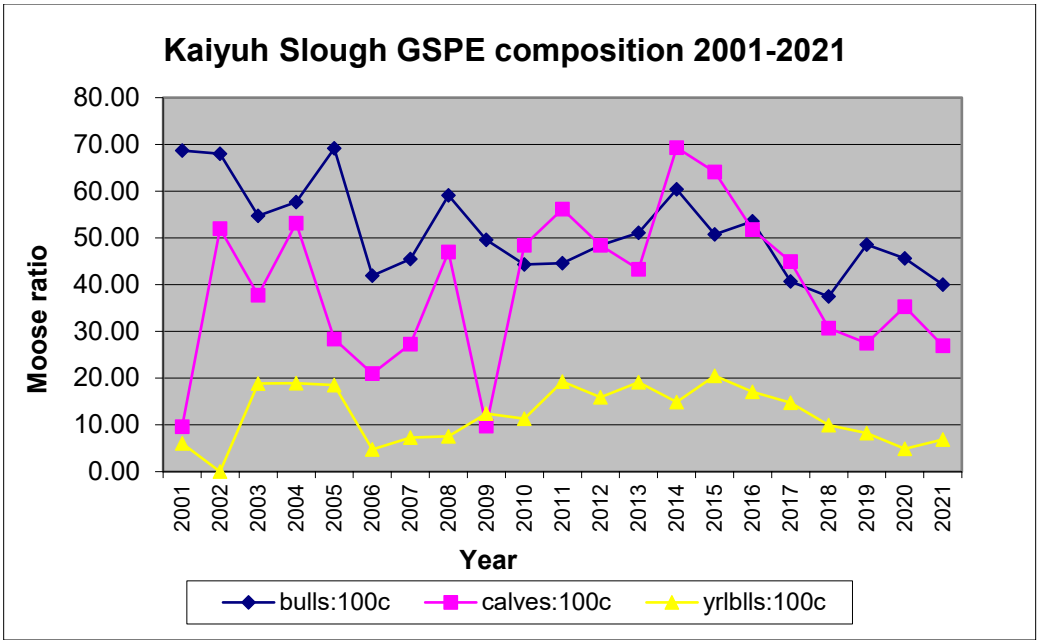

Figure 12. Kaiyuh Slough TCA ratios, GSPE 2001-2021, Kaiyuh, Alaska.

Koyukuk National Wildlife Refuge
2021 Moose Trend Count Surveys
Kaiyuh Slough Trend Count Area

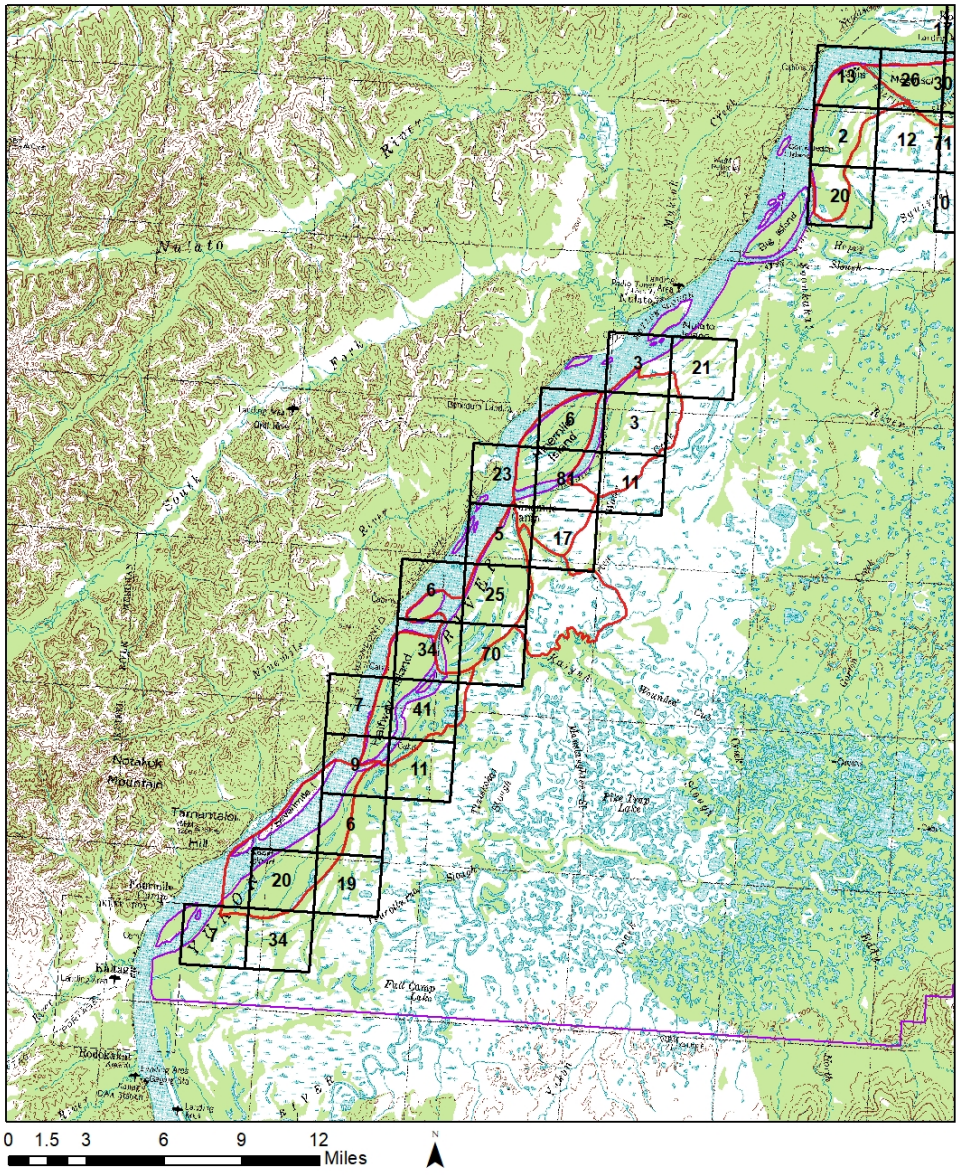

Figure 13. Kaiyuh Slough TCA 2021, N. Unit of Innoko NWR, Alaska.

Table 6. Lower Nowitna River combined TCAs, 2001-2021 GSPE Summary, Nowitna NWR, Alaska. *Low snow during survey

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/100 cows	Calves/100 cows	Yrlgbulls 100 cows	Twins/100 cows w/calvs	Total moose/mi^2	Cow moose/mi^2
Lower Novi	2001	46	284	56	386	17	16	20	6	4	1.83	1.35
Lower Novi	2003	32	255	91	378	19	13	36	7	7	1.47	0.99
Lower Novi	2004	49	238	95	382	30	21	40	13	11	1.49	0.93
Lower Novi	2005	56	237	69	362	22	24	29	9	7	1.41	0.92
Lower Novi	2006	60	272	83	415	21	22	31	8	11	1.61	1.06
Lower Novi	2007	60	229	84	373	15	26	37	7	14	1.45	0.89
Lower Novi	2008	60	213	53	326	18	28	25	8	15	1.27	0.83
Lower Novi	2009	57	264	18	339	20	22	7	8	0	1.32	1.03
Lower Novi	2010	59	216	77	352	4	27	36	2	3	1.37	0.84
Lower Novi	2011	82	273	72	427	36	30	26	13	6	1.66	1.06
Lower Novi	2012	62	217	45	324	18	29	21	8	0	1.26	0.84
Lower Novi	2013	50	199	31	280	13	25	16	7	0	1.09	0.78
Lower Novi	2014	53	138	45	236	6	38	33	4	5	0.92	0.54
Lower Novi	2015	46	166	83	295	12	28	50	7	18	1.15	0.65
Lower Novi	2016*	47	185	63	295	20	25	34	11	9	1.15	0.72
Lower Novi	2017	70	217	58	345	13	32	27	6	7	1.35	0.85
Lower Novi	2018	44	196	34	274	11	23	17	6	7	1.07	0.77
Lower Novi	2019	52	170	52	274	11	31	31	7	9	1.07	0.66
Lower Novi	2020	35	181	23	239	6	19	13	3	0	1.00	0.75
Lower Novi	2021	42	139	49	230	5	30	35	4	17	0.96	0.58

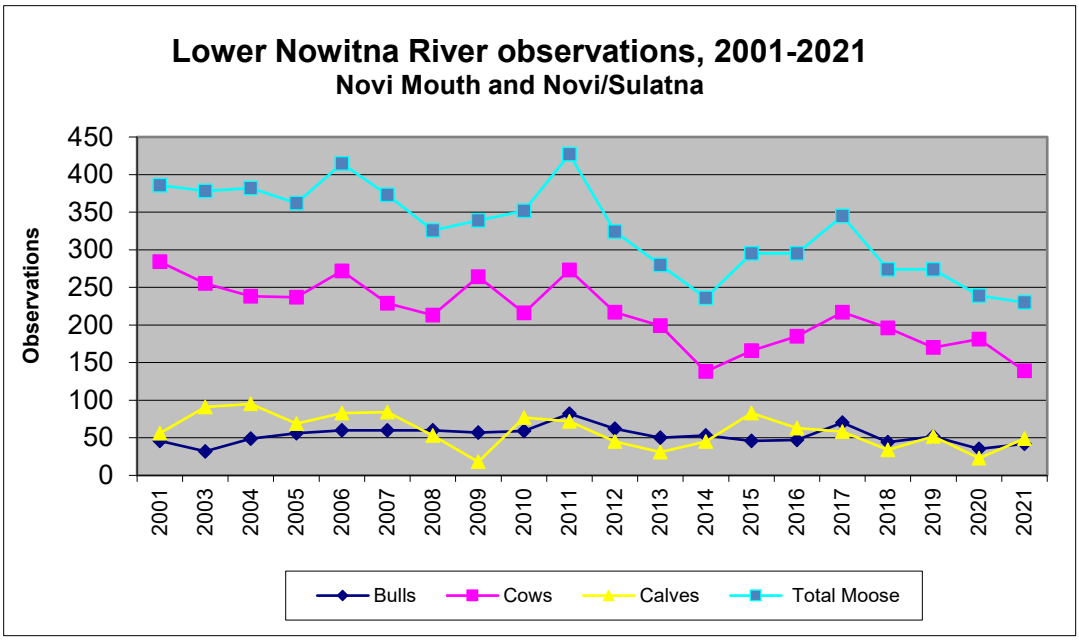

Figure 14. Lower Nowitna River observations, combined TCAs, GSPE 2001-2021, Nowitna NWR, Alaska.

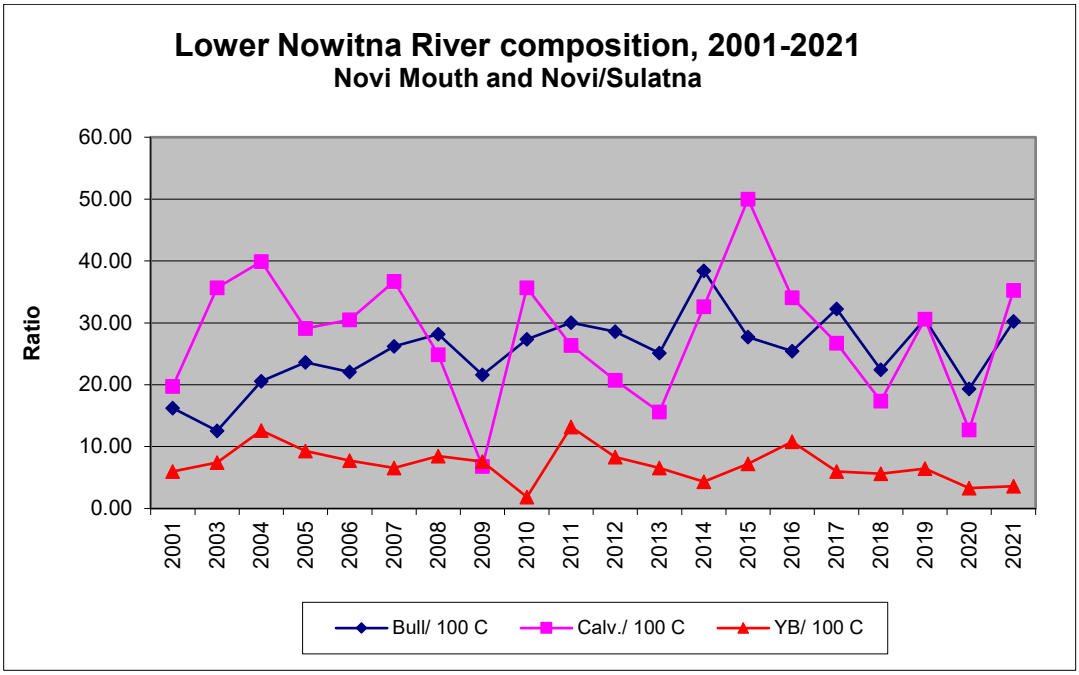

Figure 15. Lower Nowitna River ratios, combined TCAs, GSPE 2001-2021, Nowitna NWR, Alaska.

Nowitna National Wildlife Refuge
2021 Moose Trend Count Surveys
Nowitna Mouth & Nowitna/Sulatna TCAs

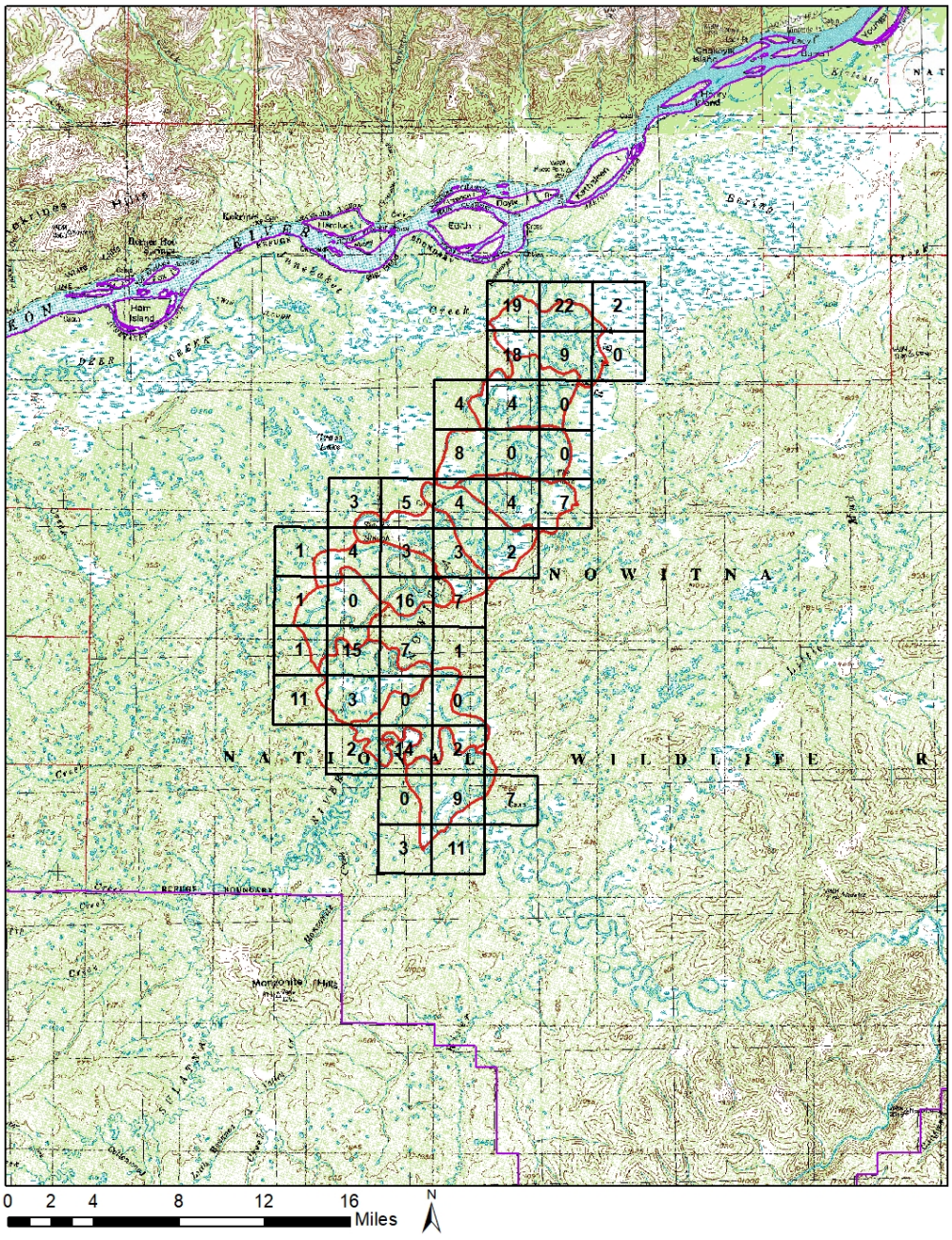

Figure 16. Lower Nowitna River TCAs 2021, Nowitna NWR, Alaska.

Table7. Innoko River TCA, 2011-2021 GSPE Summary, Innoko NWR, Alaska.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/ 100 cows	Calves/ 100 cows	Yrlg bulls/100 cows	Twins/100 cows w/calves	Area (mi^2)	Moose/ mi^2	Cows/ mi^2
Innoko River	2011	39	47	23	109	6	83	49	13	35	122	0.89	0.39
Innoko River	2012	42	57	17	116	7	74	30	12	13	122	0.95	0.47
Innoko River	2014*	60	78	44	182	14	77	56	18	22	122	1.49	0.64
Innoko River	2015	45	105	64	214	10	43	61	10	29	122	1.75	0.86
Innoko River	2016*	40	86	46	172	8	47	54	9	21	122	1.41	0.70
Innoko River	2017	62	127	67	256	16	49	53	13	16	122	2.09	1.04
Innoko River	2018	69	160	53	282	9	43	33	6	20	122	2.31	1.31
Innoko River	2019	90	167	44	301	20	54	26	12	7	122	2.47	1.37
Innoko River	2020	71	138	0	209	9	51	0	7	0	122	1.71	1.13
Innoko River	2021	23	83	41	147	1	28	49	1	28	122	1.20	0.68

*low snow in TCAs during the survey.

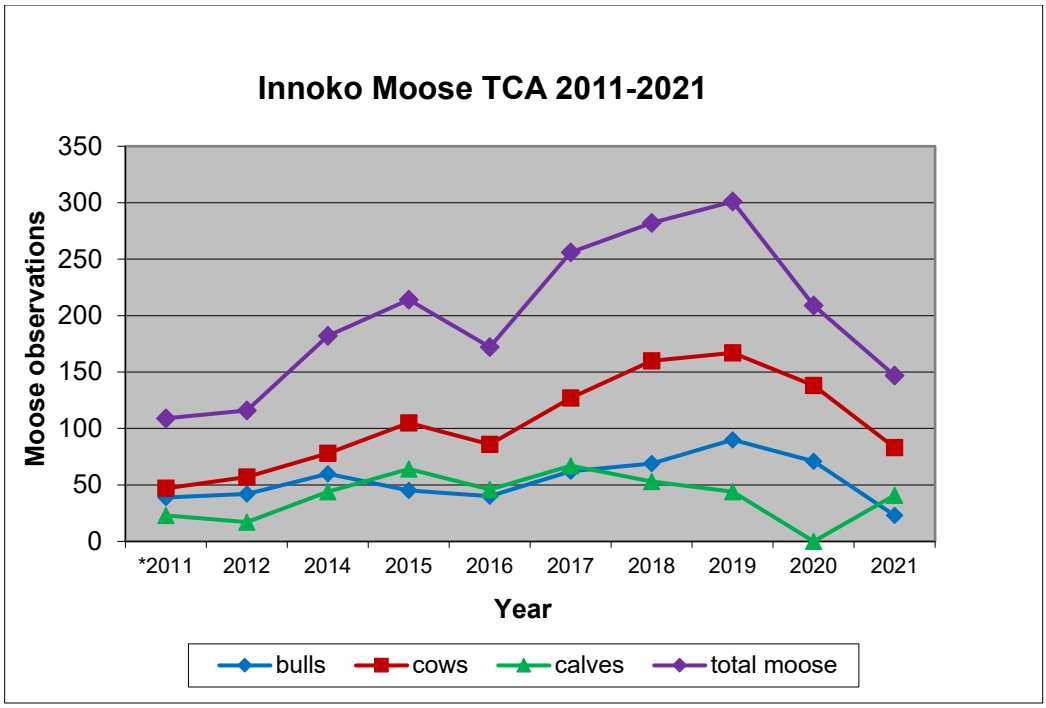

Figure 17. Innoko River TCA moose observations, 2011-2021, Innoko NWR, Alaska.

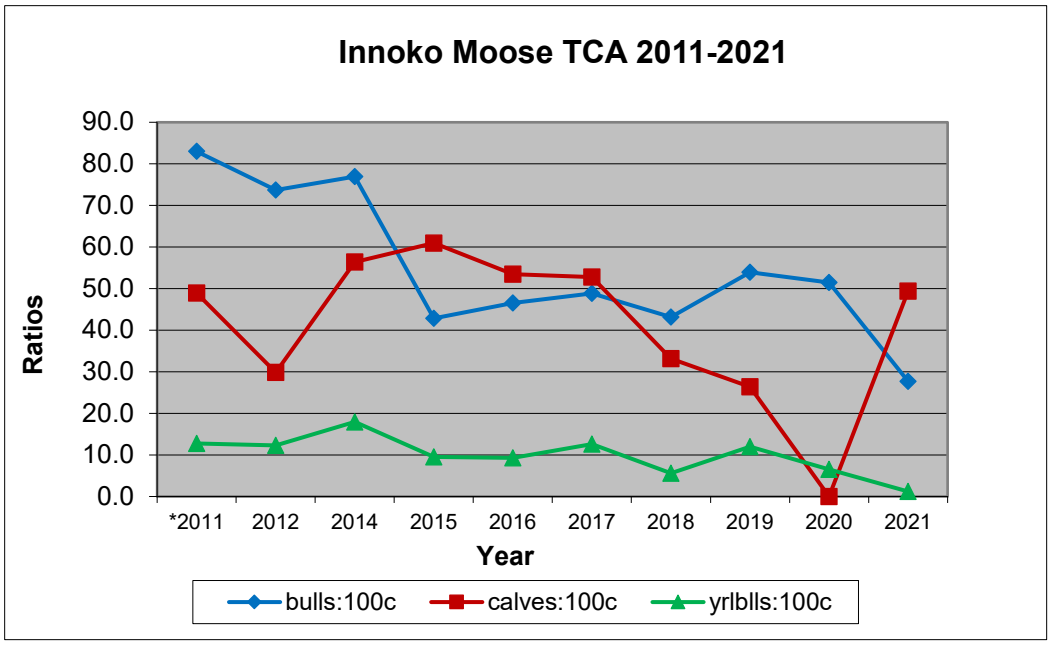

Figure 18. Innoko River TCA Ratios, 2011-2021, Innoko NWR, Alaska.

Innoko National Wildlife Refuge
2021 Moose Trend Count Surveys
Innoko River TCA

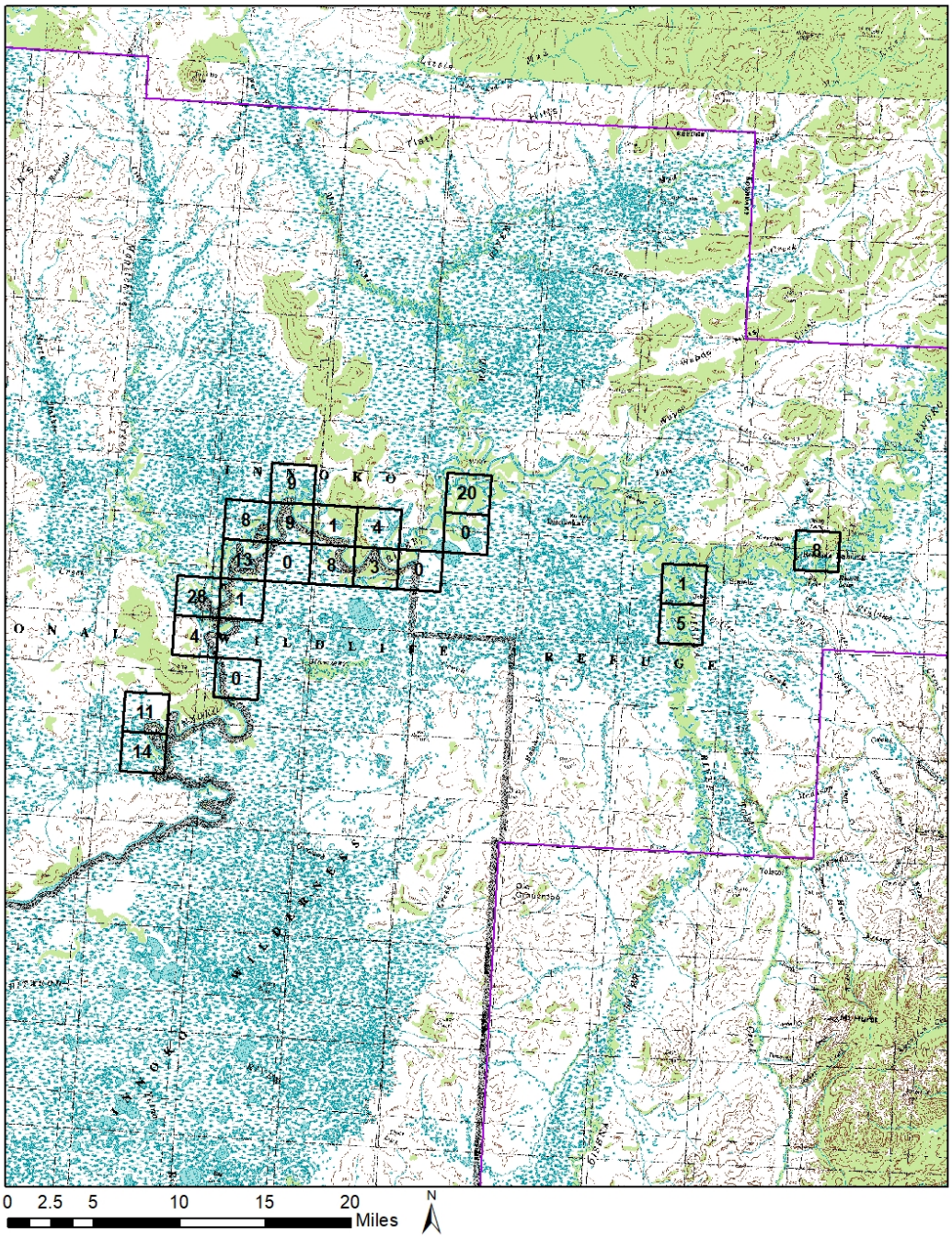

Figure 22. Innoko TCA, 2021, Innoko NWR, Alaska.

Table 9. All TCAs, Koyukuk and Kaiyuh Combined, 2001-2021 GSPE Summary, Koyukuk and Northern Unit of Innoko NWR, Alaska.

TCA	Year	Total Bulls	Total Cows	Total Calves	Total moose	Total yrlg bulls	Bulls/ 100 cows	Calves/ 100 cows	Yrlg bulls/100 cows	Twins/100 cows w/calves	Area (mi^2)	Moose/ mi^2	Cows/ mi^2
All TCAs	2001	729	2521	371	3621	156	29	15	6	2	994	3.64	2.54
All TCAs	2003	646	2592	708	3946	236	25	27	9	7	1016	3.88	2.55
All TCAs	2004	740	2544	885	4169	264	29	35	10	10	1016	4.10	2.50
All TCAs	2005	616	2342	593	3551	216	26	25	9	7	1016	3.49	2.31
All TCAs	2006	745	2546	847	4138	201	29	33	8	10	1016	4.07	2.51
All TCAs	2007	758	2421	822	4001	251	31	34	11	8	1016	3.94	2.38
All TCAs	2008	795	2586	659	4040	274	31	26	11	7	1016	3.98	2.55
All TCAs	2009	886	2893	419	4199	293	31	15	10	5	1016	4.13	2.85
All TCAs	2010	764	2594	795	4153	129	30	31	5	7	1016	4.09	2.55
All TCAs	2011	781	2638	724	4143	253	30	28	10	6	1016	4.07	2.59
All TCAs	2012*	588	2112	498	3198	140	28	24	7	6	1016	3.14	2.08
All TCAs	2013	640	2339	460	3439	166	27	20	7	4	1016	3.38	2.30
All TCAs	2014*	547	1822	509	2878	148	30	28	8	10	1016	2.83	1.79
All TCAs	2015	708	2521	1136	4364	272	28	45	11	14	1016	4.30	2.48
All TCAs	2016*	699	2340	865	3908	287	30	37	12	12	1016	3.85	2.31
All TCAs	2017	747	2920	1121	4788	291	26	38	10	12	1016	4.71	2.87
All TCAs	2018*	760	2834	802	4396	276	27	28	10	9	1016	4.32	2.79
All TCAs	2019	808	2742	740	4290	185	30	27	7	8	1016	4.22	2.70
All TCAs	2020	781	2730	672	4183	168	29	25	6	5	1016	4.12	2.69
All TCAs	2021	788	2540	724	4052	169	31	29	7	5	1016	3.99	2.50

*Low snow in some or all of the TCAs during the survey.

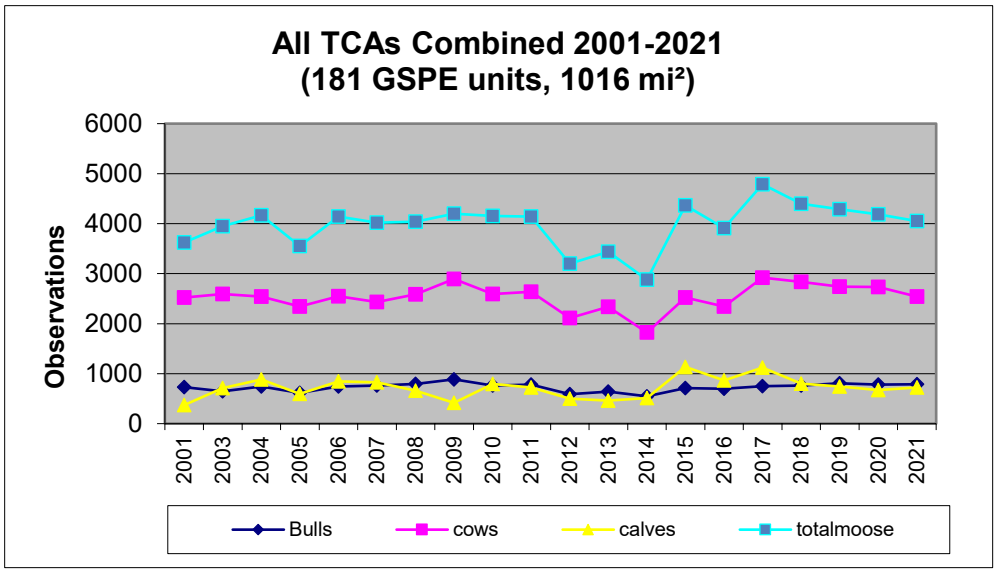

Figure 23. All TCAs combined observations, Koyukuk and Kaiyuh GSPE 2001-2021, Alaska.

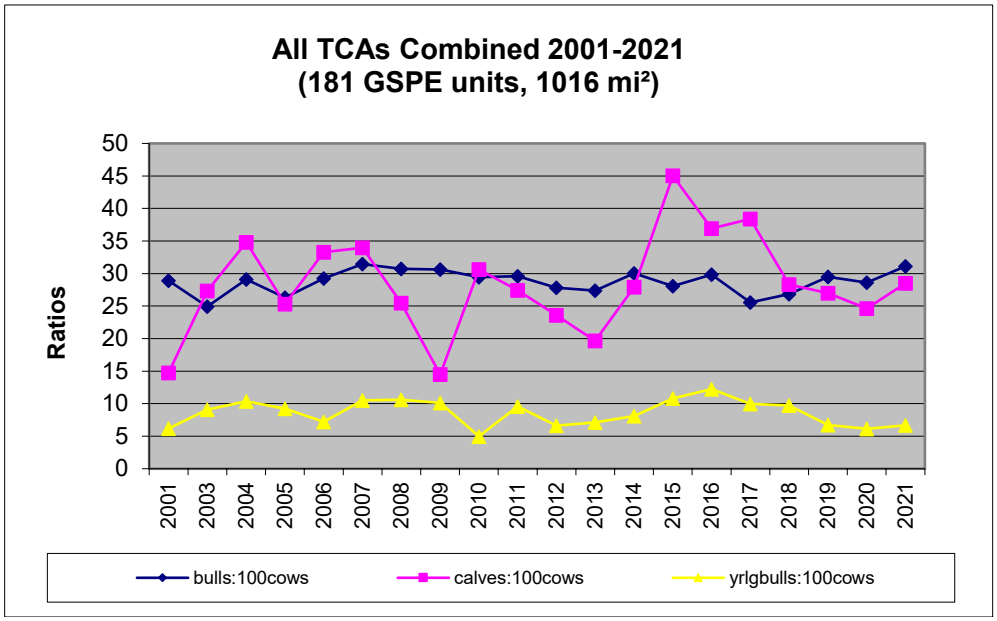

Figure 24. All TCAs combined ratios, Koyukuk and Kaiyuh GSPE 2001-2021, Alaska.

Figure 25. Trend Areas annually surveyed on Koyukuk & Northern Unit of Innoko and Nowitna NWRs, Alaska.