

STATUS OF MINNESOTA BLACK BEARS, 2018

Harvests, Complaints, Foods, Population Trends & Hunter Survey

Final Report to Bear Committee

March 19, 2019

Dave Garshelis & Andy Tri



*All data contained herein are subject to revision,
due to updated information, improved analysis
techniques, and/or regrouping of data for analysis.*

Key points

<p>Table 1 & Fig. 1</p>	<p><i>Overview: Permits, licenses, harvest, and success rates</i></p> <p>Permit applications for bear licenses exceeded 21,000 again in 2018 (as they did in 2017). Of these, >3,200 (15%), a record high number, applied for area 99, meaning that they only sought to raise their preference level for the permit system. Permit availability was the same as in 2017, but the harvest was 13% lower because natural food availability was high during fall of 2018, making hunters' baits less attractive. Hunting success is inversely related to the number of hunters but also strongly affected by fall foods.</p>
<p>Fig. 2</p>	<p><i>Bear Management Units</i></p> <p>There are currently 13 Bear Management Units (BMUs) where license sales are limited by a quota, and 4 BMUs with no quota. The BMU divisions in the no-quota zone are for internal data analysis purposes only: hunters do not have to choose a BMU in which to hunt within this zone. In the quota zone, hunters must apply for a certain BMU and are drawn through a preference lottery based on their number of previously unsuccessful applications (Table 4). The first digit in each BMU (1–5) refers to 5 larger BMUs in which each was previously a part (when numbering began in 1985). Since then several BMUs have been split, to better adjust hunting pressure. The most recent split was in 2016, when BMU 26 was divided into 27 and 28, and BMU 44 was split into 46 and 47 (BMUs 28 and 47 comprise the Leech Lake Reservation). This split, along former BMU lines, allows current data to be regrouped into these former BMUs and thereby compared to older data (which is done in this report).</p>
<p>Tables 2 & 3</p>	<p><i>Quota zone permits and licenses</i></p> <p>The number of quota zone permits available in 2018 was the same as it was for 2017 for all BMUs. This is the 6th year (since 2013) that permits have been kept low (<3,900). This was the 8th year (since 2011) of a system whereby licenses for the quota zone that were not purchased by permittees selected in the lottery could be purchased later as surplus. All surplus licenses (>400) were purchased.</p>
<p>Fig. 3</p>	<p><i>Quota zone applicants</i></p> <p>Statewide, quota zone applications increased 17% over the past 10 years, but much of that increase was for area 99 (preference level application). Among applications for specific BMUs, only BMU 45 showed a significant, steady increase, and was one of the few BMUs with higher applications in 2018 than in 2017.</p>

<p>Table 4</p>	<p><i>Quota zone lottery</i></p> <p>The low quota zone permit availability over the past 6 years has made it increasingly difficult to succeed in the lottery. This year, although quotas were the same as last year, a higher level of preference was needed to secure a permit because a large number of hunters who had accumulated preference points by previously applying to area 99 entered the lottery for a BMU. First-time applicants were successful only in BMU 22 (wilderness area hunt), and second-time applicants were successful only in BMUs 22 and 13. Four BMUs required a preference level of at least 4 for a chance of success, and BMU 45 required a preference level of 5 or above. This high threshold for BMU 45 is due to the increasing number of applicants (Fig. 3), not a change in number of available permits (Table 2).</p>
<p>Table 5</p>	<p><i>Harvest by BMU</i></p> <p>The statewide harvest in 2018 was lower than in 2017. However, BMUs along the northern edge of the state (BMU 11, 12, 13, 25) had slightly higher harvests in 2018. The most extreme declines from 2017 to 2018 were in the east-central portion of the bear range (BMUs 51 and 52; BMU 51 was the lowest since the division of these 2 BMUs in 1987; Fig. 2). The sex ratio of the harvest was $\geq 60\%$ males in all BMUs except one (BMU 31). The statewide harvest sex ratio of 66% males equaled the record set in 2015. The statewide harvest sex ratio has exceeded 60% in all years since 2013 (Table 1), when permits were reduced. However, these same highly male-biased sex ratios have also occurred in the no-quota area, suggesting that it is not just due to low hunter density.</p>
<p>Fig. 4</p>	<p><i>Harvest by quota vs no-quota zones</i></p> <p>Permit availability continuously declined during the decade 2003–2013 (Table 1), and with that, total harvests declined and the percent of the harvest in the no-quota zone increased. The percent harvest in the no-quota zone has leveled off in recent years, with stabilization of the number of quota-zone permits available, but nevertheless was a record high this year (28%), most of it occurring in BMU 11 (16% of statewide harvest; Table 5). Nearly half the bear hunters were hunting with a no-quota license in 2017 and 2018.</p>
<p>Table 6</p>	<p><i>Hunting success by BMU</i></p> <p>Record-breaking success was experienced by hunters in 2016 and 2017. In 2018, success was generally lower, yet was still exceptionally high in many areas ($>50\%$ in BMUs 12, 13, 25; 60% in BMU 28 [which has a high proportion of guided hunters]). Success rate in the no-quota zone as a whole (15%) was less than half that in the quota zone (38%). The distribution of hunters within the no-quota zone is gleaned from where they said they would hunt when they purchased their license: a growing proportion indicated that they planned to hunt in BMU 10 (although the hunting success rate in this area is lowest in the state).</p>

<p>Table 7</p>	<p><i>Harvest by date</i></p> <p>During years of normal fall food abundance, about 70% of the harvest occurs during the 1st week of the bear season, and ~83% occurs by the end of the 2nd week. During years with abundant fall foods, the harvest is shifted later in the season, with <60% occurring during the first week. This delayed pattern occurred in 2018.</p>
<p>Table 8 & Fig. 5</p>	<p><i>Nuisance complaints and kills</i></p> <p>The total number of recorded bear complaints slowly increased over the past decade, reaching a peak in 2015 and 2016. Number of complaints declined in 2017, despite a higher number of DNR personnel recording complaints, and declined again in 2018, with abundant natural foods all summer (Tables 9 & 10). A new recording system was instituted in 2017 whereby Wildlife Managers recorded all bear complaints online as they were received, instead of submitting reports at the end of each month (thus, unlike previous years, Managers who had no complaints were not counted in the number of personnel participating). Conservation Officers continued to use the monthly reporting system (and recorded zero when they had no complaints). In 2018, although the total number of complaints was the lowest since 2011, hotspots of nuisance activity were apparent: Little Falls, Park Rapids, Brainerd, Bemidji (all with 30–50 recorded complaints) and Cloquet (85 complaints). The number of nuisance bears killed equaled that of 2011, the lowest since recording began in 1982. In 2018 a list was distributed of 116 “area 88” hunters, who expressed interest in taking a nuisance bear in the quota area on a no-quota license. We have no records of any hunters doing so (it is unclear how many were authorized to do so).</p>
<p>Tables 9–11 & Fig 6</p>	<p><i>Food abundance</i></p> <p>The composite range-wide, all-season abundance of natural bear foods (fruits and nuts) in 2018 was the second highest on record and considerably higher than 2015–2017. Abundance of nearly all the summer foods was well above the long-term (34-year) average, in all but the west-central region. On the other hand, fall foods were high in the west-central and east-central regions. The statewide fall food index (productivity of dogwood+oak+hazel), which helps predict annual harvest after accounting for hunter effort (Fig. 7), was the highest since 2002, because fall foods were so high in the west-central and east-central areas (but near normal in the northwest). Hazelnut production was average in the northwest, and above-average in most other areas (with patches of exceptional production). Dogwood production was generally above-average across the range. Oak production occurred in 3 bands, increasing from average to exceptional along a northwest to southeast gradient.</p>

<p>Fig. 7</p>	<p><i>Predictions of harvest from food abundance</i></p> <p>The 2018 statewide harvest was close, but slightly higher than expected (1766 actual vs. 1715 predicted), based on regression of harvest as a function of hunter numbers and the fall food productivity index. This regression is even stronger (and has accurately predicted previous harvests) when only the past 15 years are considered. For the quota zone, the actual harvest in 2018 was also close but higher (1272 actual vs. 1201 predicted) than predicted by this regression.</p>
<p>Fig. 8</p>	<p><i>Harvest sex ratios</i></p> <p>Harvest sex ratios within BMUs varied considerably year-to-year over the past 2 decades. Five BMUs have shown a significantly increasing trend in percent males during 1998–2018; these were not concentrated in a single region but rather represent the northwest (BMU 13), north-central (BMU 25, 26), and southeastern (BMU 51, 52) portions of the bear range (and include both quota and no-quota areas). Statewide there has been a clear shift toward more males in the harvest (see Fig. 10). Sex ratios of harvested bears reflect both the sex ratio of the living population (which varies with harvest pressure) as well as the relative vulnerability of the sexes to hunters (which varies with natural food conditions, hunter selectivity, and possibly density of baits).</p>
<p>Figs. 9–11</p>	<p><i>Harvest ages</i></p> <p>Statewide, the median age of harvested females dipped below 3 years old, breaking what had been a 3-year upward trend. Likewise, the proportion of the female harvest composed of 1–2 year-olds increased slightly and 4–10 year-olds decreased. On a BMU-basis, median ages of harvested females has not shown an obvious trend over the past 20 years. However, it is notable that BMUs 45 and 52 had especially young females harvested in 2018 (median ages <2 years in both of these BMUs). This was likely a result of the abundant fall foods in the southern portion of the bear range: it is common for older females in particular to shun hunters' baits when natural foods are abundant. The median age of harvested males (slightly over 2 years old statewide) has been relatively stable, but creeping upward.</p>
<p>Figs. 12–13</p>	<p><i>Submission of bear teeth for aging</i></p> <p>Ages of harvested bears are used as the principal means of monitoring population trends. Although hunters are required to submit a tooth from their harvested bear, historically >25% did not comply. Reminder notices were sent to non-compliant hunters each year during 2014–2017, which spurred a higher initial compliance the following years (>80%). However, ~90% compliance was achieved only through a reminder mailing. In 2018 no reminder mailing was sent and compliance was 85%. Since 2013, hunters could register by phone or internet, and pick up a tooth submission envelope later: tooth submission compliance by these hunters has been significantly less than for hunters who registered their bear in person and picked up a tooth envelope at that time. Less than 80% of successful hunters in BMUs 41, 46, and 10 submitted a tooth.</p>

Population trend statewide

Ages of harvested bears accumulated since 1980 were used to reconstruct minimum statewide population sizes through time (i.e., the size of the population that eventually died due to hunting) using a technique formulated by Downing. This was scaled upwards (to include bears that died of other causes), using 4 statewide tetracycline mark-recapture estimates as a guide. One trajectory, which assumed non-harvest mortality was 23% of total mortality (curves elevated x1.3) matched the 1991 tetracycline estimate, but fell below the other tet-estimates. Another trajectory, which assumed non-harvest mortality was 44% of all mortality (curves elevated x1.8) matched the 1997, 2002, and 2008 tet-estimates.

This year another population trajectory was added, derived from a Bayesian model recently developed by Allen et al. (2018) for bear monitoring in Wisconsin. Besides the sex-ages of harvested bears, this model also includes reproductive and survival parameters.

From 1980 to 2000, the Allen matched the Downing model that included 23% non-harvest mortality. But in the last 10 years, the Allen model better matched the Downing model with 44% non-harvest mortality. However, whereas both models show a decline since the late 1990s, that decline is much less steep in the Allen model.

Since 2013, quotas were maintained at a low and consistent level (Table 2) in an attempt to reverse the population decline (and also to allow the models to perform better, without the confounding issue of changing hunter effort). The Downing model indicates the reduced hunting pressure has worked, enabling a population increase from 2014 to 2016 (although estimates for 2017 and 2018 are not obtainable with this model). The Allen model, in contrast, shows a continued decline until pre-hunt 2015, and then a leveling off (at 11–12,000 bears, excluding cubs) through 2018.

Of note, Downing population reconstruction assumes equal harvest pressure through time. As harvest pressure is diminished, and fewer bears are killed (as has been the trend since 2003), non-harvest mortality should comprise a greater proportion of total mortality. Therefore, it is possible that the Downing curve should be higher in recent years (which have lower harvest rates; see Fig. 16). That would make the disparity between the Allen and Downing trajectories greater during the most recent years.

Fig. 14

<p>Fig. 15</p>	<p><i>Population trend: quota vs no-quota zones</i></p> <p>Downing reconstruction indicated vastly different population trajectories for the quota and no-quota zones. Whereas the quota zone has shown a decline of about 50% of the population from 2000 to 2014, the no-quota zone remained relatively stable. With reduced quotas and lower harvests since then, the quota zone population increased almost 10% in 2 years (2014–2016), according to this model. Meanwhile, despite a surge in “overflow” hunters in the no-quota zone (Fig. 4) prompted by the lower number of quota zone permits available, harvests in the no-quota zone have not increased, and the Downing model shows a recent population increase.</p> <p>The Downing model does not produce population estimates for the most recent 2 years, so the effects of the high harvest in 2016 (in both quota and no-quota zones) is not yet reflected in the trajectories of this model.</p>
<p>Fig. 16</p>	<p><i>Trends in harvest rates</i></p> <p>The sex ratio of harvested bears varies by age in accordance with the relative vulnerability of the sexes. Male bears are more vulnerable to harvest than females, so males always predominate among harvested 1-year-olds (67–75%). Males also predominate, but less strongly among 2 and 3-year-old harvested bears. However, older-aged harvested bears (≥ 8 years) are nearly always dominated by females, because, although old females continue to be less vulnerable, there are far more of them than old males in the living population. The age at which the line fitted to these proportions crosses the 50:50 sex ratio is approximately the inverse of the harvest rate. Segregating the data into time blocks showed harvest rates increasing from 1980–1999, then declining with reductions in hunter numbers (Fig. 1). Based on this method, harvest rates since 2015 have been significantly less than what they were in the early 1980s, when the bear population was increasing (Fig. 14).</p> <p>One problem in using this very simple method is that it assumes that the relative difference for males versus females in their vulnerability to harvest does not change systematically through time. This may not be true, given the steadily increasing male-skewed harvests since the late 1990s, and especially in recent years (Fig. 10).</p>
<p>Table 12 & Fig. 17</p>	<p><i>Hunter experience, methods, and effort</i></p> <p>A bear hunter survey was employed to assess changes in hunter effort and hunting methods over time, comparing periodic hunter surveys conducted over a 30-year period, 1988–2018. A random sample of 61% of all hunters were surveyed this year (4000 total surveys), of which responses were received from 55% in the quota zone and 40% in the no-quota zone. Hunters have gained bear hunting experience over time and a preponderance of hunters now use trail cameras (87% in quota zone, 78% in no-quota). However, type of weapon, use of bait, use of guides, and number of days hunting (mean = 6.3) has remained relatively stable, at least during the 2000s. Fewer hunters indicated passing up a shot at a bear than previously. Those that did pass up a shot did so mainly seeking a larger bear or to avoid shooting a female with cubs. The percentage of hunters who passed-up shooting a bear was virtually the same in quota and no-quota zones.</p>

<p>Fig. 18 & 19</p>	<p><i>Hunter reactions to hunter density & low quotas</i></p> <p>Few hunters indicated that low hunter density (less competition, due to low quotas) made them more selective in the bear they shot (and quota and no-quota hunters answered this similarly). However, quota hunters and no-quota hunters in BMUs 10 & 11 enjoyed their hunt more than no-quota BMU 52 hunters, because BMU 52 was more crowded (at least in spots). Hunters in the quota zone indicated that restrictive quotas improved the hunt and allowed the population to grow, but they said that the longer wait times between being drawn for a permit made them less willing to pass-up a shot. A vast majority indicated that more quota zone licenses should be issued.</p>
<p>Fig. 20 & 21</p>	<p><i>Hunter opinions of status of bear population</i></p> <p>Nearly 80% of hunters expressed an opinion of the status of the bear population in the general area where they hunted. Among these, over half thought the local population was stable, nearly 40% thought it was increasing, and 10% thought it was declining. Opinions of population status differed by BMU. Roughly half the hunters in quota BMUs 12, 41, 46, and no-quota BMUs 10 & 11 thought local populations of bears were increasing. BMU 45 stood well above the rest: 75% of hunters there thought the population was increasing, possibly explaining why this BMU has become so popular to hunt (see Fig. 3), and therefore the most difficult to get drawn for a permit (see Table 4).</p>

Table 1. Bear permits, licenses, hunters, harvests, and success rates, 1998–2018.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Permit applications ^a	30245	29384	29275	26824	21886	16431	16466	16153	15725	16345	17362	17571	18647	19184	18103	18107	18885	18422	19958	21034	21184
Permits available ^b	18210	20840	20710	20710	20610	20110	16450	15950	14850	13200	11850	10000	9500	7050	6000	3750	3750	3700	3850	3350	3350
Licenses purchased (total)	16737	18355	19304	16510	14639	14409	13669	13199	13164	11936	10404	9892	9689	9555	8986	6589	6620	6962	7177	6655	6550
Quota zone ^c	14941	16563	17021	13632	12350	9833	10063	9340	9169	8905	7842	7342	7086	5684	4951	3188	3177	3257	3420	2954	2922
Quota surplus/military ^c				235	209	2554	1356	1591	1561	526	233	77	83	1385	1070	578	583	446	441	401	428
No-quota zone ^c	1796	1792	2283	2643	2080	2022	2238	2268	2434	2505	2329	2473	2520	2486	2965	2823	2860	3259	3316 ^h	3300 ^h	3200
% Licenses bought																					
Of permits available ^d	82.0	79.5	82.2	67.0	60.9	61.6	69.4	68.5	72.3	71.4	67.7	73.4	74.6	100	100	100	100	100	100	100	100
Of permits issued ^d	84.4	87.2	83.9	69.8	66.3	65.7	68.3	67.1	68.9	70.0	67.2	73.8	74.5	80.7	82.7	85.0	84.7	87.9	88.7	88.2	87.2
Estimated no. hunters ^e	14500	15900	16800	15500	13800	13600	12900	12500	12500	11300	9900	9400	9200	9200	8600	6300	6300	6700	6900	6400	6300
Harvest	4110	3620	3898	4936	1915	3598	3391	3340	3290	3172	2135	2801	2699	2131	2604	1866	1627	1971	2641	2040	1766
Harvest sex ratio (%M) ^f	55	53	58	56	61	58	57	59	58	57	62	59	59	61	59	62	62	66 ⁱ	61	63	66 ⁱ
Success rate (%)																					
Total harvest/hunters ^g	28	23	23	29	14	26	26	26	26	28	21	30	29	23	30	30	26	30	38	32	28
Quota harvest/licenses	25	20	20	28	14	25	26	25	25	28	21	30	30	24	33	37	33	39 ^j	50 ^j	46 ^j	38

^a From 2008 to 2018, includes area 99, a designation to increase preference but not to obtain a license (2008 = 528, 2009 = 835; 2010 = 1194; 2011 = 1626; 2012 = 1907; 2013 = 2129; 2014=2377; 2015=2455; 2016=2641; 2017=2803; 2018=3254 (record high); additionally, area 88 nuisance-only bear license applications counted in this total in 2017=3 and 2018=6 (people who selected area 88 as 1st preference).

^b Beginning in 2011 a procedure was implemented that ensures that all available licenses are purchased (see Table 2).

^c Quota zone established in 1982. No-quota zone established in 1987. Surplus licenses from undersubscribed quota areas sold beginning in 2000; originally open only to unsuccessful permit applicants, but beginning in 2003, open to all. In 2011, surplus licenses offered for all lottery licenses not purchased by August 1. Free licenses for 10 and 11 year-olds were available beginning 2009.

^d Quota licenses bought (including surplus)/permits available, or licenses bought (prior to surplus)/permits issued. Beginning in 2008, some permits were issued for area 99; these are no-hunt permits, just to increase preference, and are not included in this calculation. In 2011–18, all unpurchased licenses were put up for sale and were bought.

^e Number of licensed hunters x percent of license-holders hunting. Percent hunting is based on data from bear hunter surveys conducted during 1981–91, 1998 (86.8%), 2001(93.9%) and 2009 (95.3%). Beginning in 2011 all unpurchased quota licenses were sold as “surplus” in August, and this process is quick and competitive; thus, for 2011–18 all Surplus and Military license-holders were considered to have hunted.

^f Sex ratio as reported by hunters; hunters classify about 10% of female bears as males, so the actual harvest has a lower %M than shown here. In good food years, the harvest is more male-biased.

^g Success rates in 2001–2012 were calculated as number of successful hunters/total hunters, rather than bears killed/total hunters, because no-quota hunters could take 2 bears. After 2012, hunters could take 2 bears only if they bought 2 licenses (1 quota + 1 no-quota). In both 2016 and 2017, 5 hunters legally killed 2 bears. In 2018, 3 hunters shot 2 bears.

^h Record high number of no-quota zone licenses purchased in 2016; record high % of licenses in no-quota zone in 2017 (nearly 50%; see Fig. 4).

ⁱ Record high % males in statewide harvest.

^j 2015: highest success rate in quota zone since very poor food year of 1995; 2016: record high success rate; 2017: second-highest success rate.

Fig. 1. Relationship between licenses sold and hunting success (*note inverted scale*) in quota zone, 1987–2018 (quota and no-quota zones first partitioned in 1987). Number of licenses explains 47% of variation in hunting success during this period. Large variation in hunting success is also attributable to food conditions (e.g., during 2013–2018, when licenses were held relatively constant).

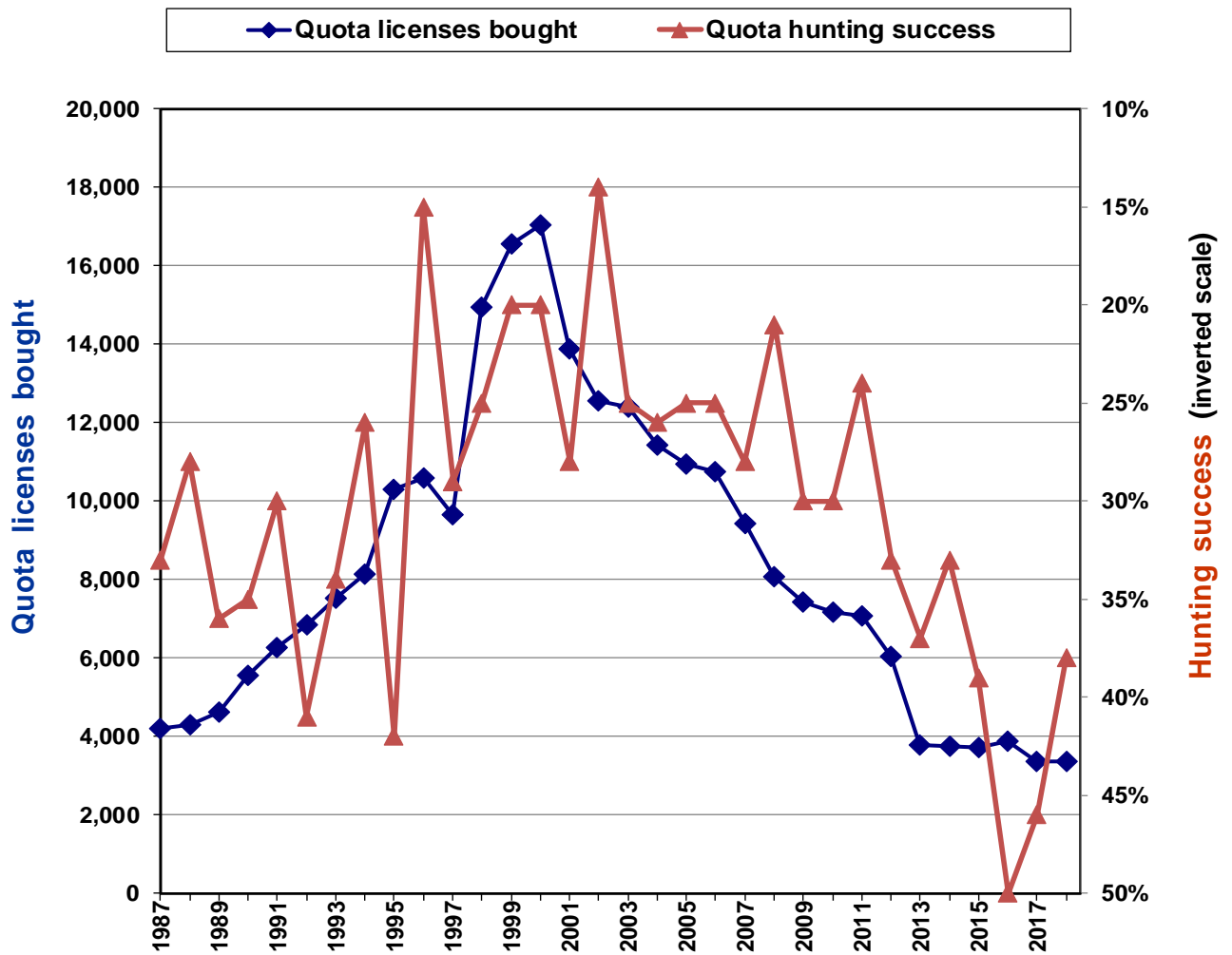


Table 2. Number of bear hunting quota area permits available, 2013–2018. Highlighted values show a change from the previous year. BMUs 26 and 44 were divided into 27/28 and 46/47, respectively, in 2016.

BMU	2013	2014	2015	2016		2017	2018
				Before BMU split ^a	After BMU split		
12	200	200	150	150	150	125	125
13	250	250	250	250	250	225	225
22	50	50	50	50	50	50	50
24	200	200	200	200	200	175	175
25	500	500	500	500	500	400	400
26	350	350	350	325			
27					250	225	225
28					75	60	60
31	550	550	550	550	550	500	500
41	150	150	150	125	125	125	125
44	450	450	450	450			
46					400	350	350
47					50	40	40
45	150	150	150	250	250	175	175
51	900	900	900	1000	1000	900	900
Total	3750	3750	3700	3850	3850	3350	3350

^a In 2016, the Leech Lake Reservation was split from BMUs 26 and 44 to form BMUs 28 (north) and 47 (south), with the remaining area of BMU 26 renamed BMU 28 and remaining area of BMU 44 renamed BMU 46. The column shows permit allocation before the split in order to compare with previous years.

Table 3. Number of quota BMU permit applicants (Apps), licenses bought (after permits drawn) and surplus licenses bought, 2013–2018^a. Shaded values indicate undersubscribed (applications less than permits available).

BMU	2013			2014			2015			2016			2017			2018		
	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought	Apps	Bought license	Surplus bought
12	707	160	44	661	164	36	612	130	20	624	133	17	774	113	12	703	109	16
13	664	213	37	703	218	32	692	210	40	716	221	29	772	200	25	682	177	47
22	55	36	14	65	33	17	48	36	9 ^b	52	37	13	47	34	16	76	36	14
24	763	170	30	875	174	26	771	171	29	884	173	27	945	158	17	928	155	20
25	1575	432	69	1533	424	76	1396	433	67	1443	440	60	1651	354	46	1561	355	44
26	1695	303	47	1696	298	52	1650	309	42									
27										1224	219	31	1297	197	28	1265	204	21
28										325	72	3	330	52	8	309	52	8
31	2261	478	72	2257	468	82	2021	488	62	2180	489	62	2076	441	59	2074	428	71
41	575	135	15	561	129	21	570	129	21	618	114	11	614	109	16	648	114	11
44	2682	386	65	2751	393	57	2626	402	48									
46										2690	370	30	2774	319	31	2769	317	33
47										194	45	5	214	33	7	182	35	5
45	1205	141	9	1403	127	23	1703	139	11	2046	227	23	2323	161	14	2383	160	15
51	3796	734	166	4003	748	152	3878	810	90	4321	880	121	4411	783	117	4344	779	123
Total ^c	15978	3188	568	16508	3176	574	15967	3257	439	17317	3420	432	18228	2954	396	17924	2921	428

^a Beginning in 2011, all licenses not purchased by permittees were sold as “surplus”. In all cases but one (see footnote b), all of the surplus licenses were purchased. Surplus = Permits available (Table 2) minus Bought license (±4 to account for groups applying together).

^b Even after purchase of surplus licenses, this BMU remained undersubscribed.

^c Beginning in 2008, applicants could apply for area 99 in order to increase future preference, but not buy a license; these are not included in the total number of applications (unlike Table 1, where they are included).

Fig 3. Trends in number of applicants for quota zone permits by BMU over past 10 years, 2009–2018. For 2016–2018, BMUs 27 and 28 were grouped into old BMU 26 and BMUs 46 and 47 were grouped into old BMU 44. BMU 45 is highlighted because applications there surged over this time period.

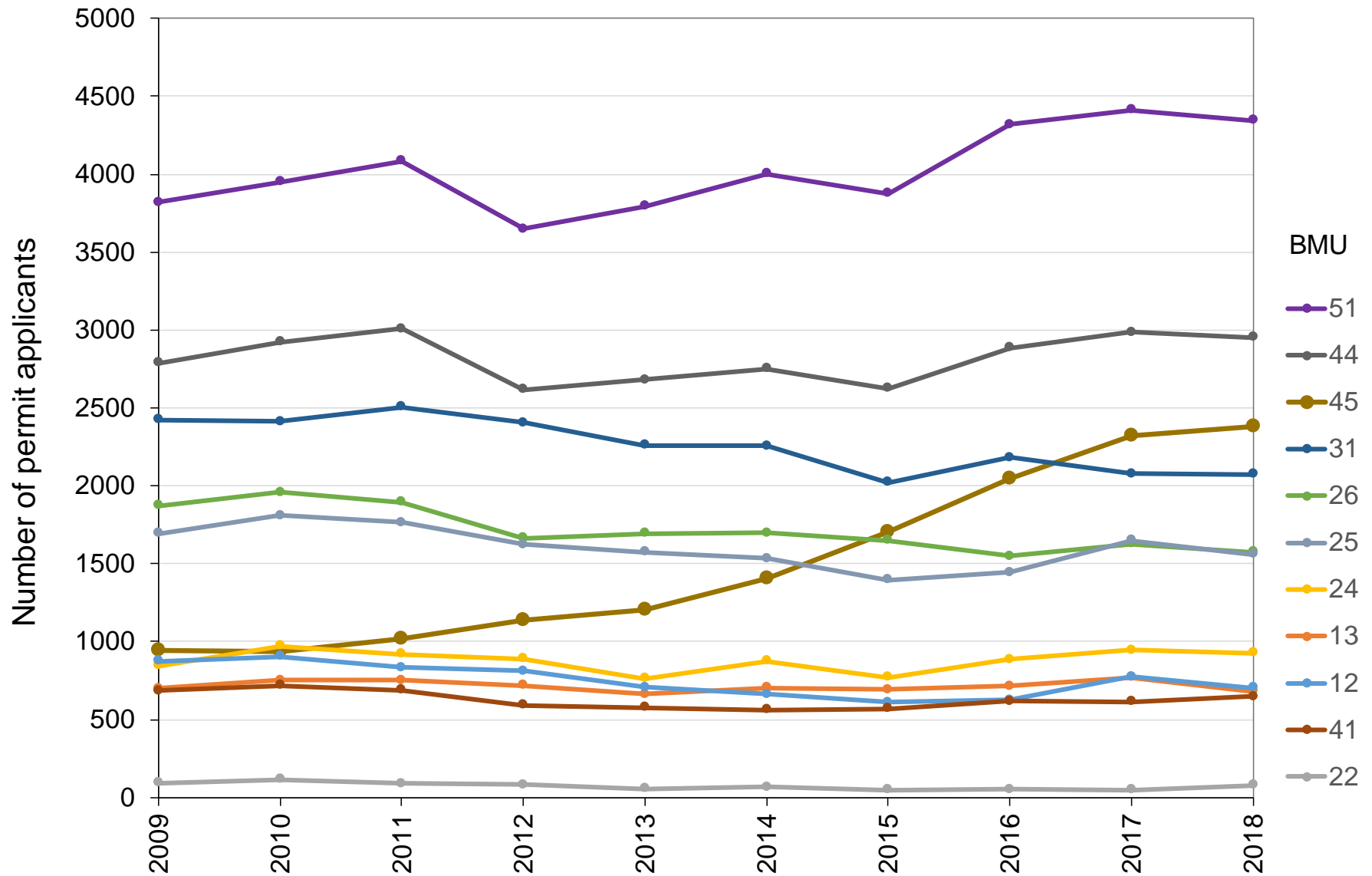


Table 4. Percent of quota BMU lottery applicants with preference levels 1 (1st-year applicants), 2, 3, and 4 who were drawn for a bear permit during 2013–2018. Blank spaces indicate 100% of applicants were drawn. All preference level 2 applicants were drawn, except where 0 preference level 1 applicants were drawn. Likewise, all preference level 3 applicants were drawn, except where 0 preference level 2 applicants were drawn^a.

BMU	2013			2014			2015				2016				2017				2018				
	Pref 1	Pref 2	Pref 3	Pref 1	Pref 2	Pref 3	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4	Pref 1	Pref 2	Pref 3	Pref 4	Pref 5
12	0	49		0	40		0	17			0	0	98		0	0	57		0	0	41		
13	4			0	72		0	56			0	38			0	16			0	11			
22	89			72			100				98				100				60				
24	0	41		0	13		0	2			0	0	86		0	0	57		0	0	26		
25	0	81		0	57		0	44			0	42			0	6			0	0	80		
26 ^b	0	7		0	0	80	0	0	51														
27											0	0	30		0	0	2		0	0	0	85	
28											0	0	0	99	0	0	0	76	0	0	0	46	
31	0	45		0	15		0	0	87		0	0	75		0	0	67		0	0	48		
41	0	43		0	19		0	0	99		0	0	77		0	0	56		0	0	27		
44 ^b	0	0	68	0	0	41	0	0	18														
46											0	0	0	85	0	0	0	51	0	0	0	24	
47											0	0	10		0	0	0	49	0	0	0	26	
45	0	0	75	0	0	30	0	0	0	81	0	0	0	63	0	0	0	16	0	0	0	0	72
51	0	53		0	22		0	0	89		0	0	72		0	0	54		0	0	35		

^a As an example, in 2018: BMU 12: 0% of preference level 1 and 2 applicants were drawn, 41% of preference level 3, and 100% of preference level 4 and above were drawn for a permit; BMU 22: 60% preference level 1 applicants were selected, 100% all higher preference levels; BMU 45: no preference level 1–4 applicants were drawn, 72% of hunters with preference 5 were drawn, and 100% of hunters with preference level 6 and above were drawn.

^b BMU 26 was split into 27/28 and BMU 44 was split into 46/47 in 2016.

Table 5. Minnesota bear harvest tally for 2018 by Bear Management Unit (BMU)^a and sex^b compared to harvests during 2013–2017 and record high and low harvests (since establishment of each BMU, not counting current year).

BMU	2018				2017	2016	2015	2014	2013	5-year mean	Record low harvest (yr)	Record high harvest (yr)
	M	(%M)	F	Total								
Quota												
12	42	(64)	24	66	54	78	60	38 ^d	62	58	38 (14)	263 (01)
13	84	(71)	35	119	100	147	72 ^e	91	95	101	71 (88)	258 (95)
22	3	(75)	1	4	8	5	7	5	9	7	3 (03)	41 (89)
24	37	(62)	23	60	81	96	97	50 ^f	76	80	50 (14)	288 (95)
25	149	(67)	74	223	212	287	227	168 ^g	197	218	149 (96)	584 (01)
26	[94]	[67]	[47]	[141]	[162]	[171]	121	117 ^h	121	138	117 (14)	513 (95)
27	70	(70)	35	105	120	131						
28	24	(67)	12	36	42	40						
31	125	(59)	86	211	262	312	307	221	197	260	157 (88)	697 (01)
41	36	(62)	22	58	61	57	35 ⁱ	36	40	46	35 (15)	201 (01)
44	[102]	[66]	[52]	[154]	[158]	[215]	158	170	181	176	130 (11)	643 (95)
46	93	(67)	46	139	141	190						
47	9	(60)	6	15	17	25						
45	33	(64)	18	51	77	102 ^m	55	54	48	67	32 (11)	178 (01)
51	131	(71) ⁿ	54	185 ^d	372	463	302	291	349	355	247 (91)	895 (01)
Total	836	(66)	436	1272	1547	1933	1441	1241 ^j	1375	1507	1192 (88)	4288 (01)
No-Quota												
11	193	(67)	94	287	179	291	195	77 ^k	136	176	38 (87)	351 (05)
10	16	(76)	5	21 ⁿ	18	15	11	8	9	12		18 (17)
52	127	(68)	59	186 ^p	295	402	324	301	346	334	105 (02)	405 (12)
60 ^c	0		0	0	1	0	0	0	0			
Total	336	(68)	158	494	493	708 ⁿ	530	386	491	522	198 (87)	708 (16)
State	1172	(66) ⁿ	594	1766	2040	2641	1971	1627 ^j	1866	2029		4956 (95)

^a Some tooth envelopes were received from hunters who did not register their bear. These were added to the harvest tally:

2013:6; 2014:3; 2015:6; 2016:7; 2017:4; 2018:2

Some hunters with no-quota licenses hunted in the quota zone, and their kills were assigned to the BMU where they apparently hunted:

2013:11; 2014:4; 2015:12; 2016:9; 2017:2; 2018:4*

*None were authorized NQ license-holders hunting in quota zone.

Some quota area hunters also apparently hunted in the wrong BMU, based on the block where they said they killed a bear, but these were recorded in the BMU where they were assigned (presuming most were misreported kill locations).

^b Sex recorded on tooth envelopes may differ from the registered sex. Sex shown on table is the registered sex.

^c BMU 60 designates SE Minnesota, which is within No-quota zone. The only hunter-harvested bear in this area was in 2017.

Notable harvests:

^d Record low harvest since this area was established in 1987.

^e Lowest harvest since 1988.

^f Record low harvest since this area was established in 1989.

^g Lowest harvest since 1996.

^h Record low harvest since this area was established in 1991.

ⁱ Record low harvest since this area was established in 1990.

^j Lowest harvest since 1988 (quota—no-quota split in 1987).

^k Lowest harvest since 1999.

^m Highest harvest since 2007.

ⁿ Record high harvest.

^p Third lowest harvest since established as NQ area in 1987

^q Record high % males (or tie for record).

Fig. 4. Trends in statewide bear harvest and proportions of harvest and licenses in the no-quota zones, 1987–2018.

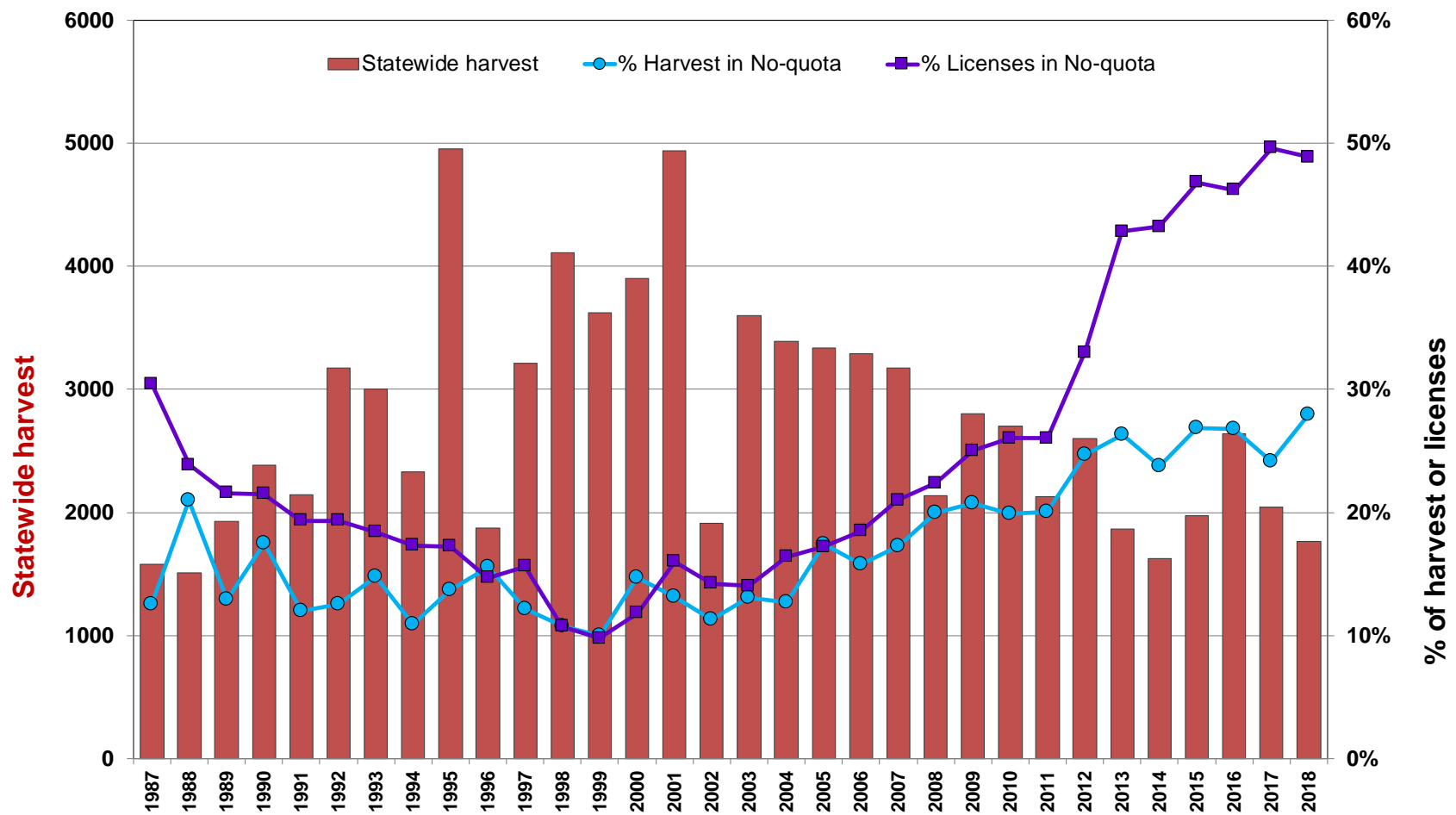


Table 6. Bear hunting success (%) by BMU, measured as the registered harvest divided by the number of licenses sold^a, 2013–2018.

BMU	Max success (yr) before 2018		Mean success 2013–2017	2018	2017	2016	2015	2014	2013
12	52	(16)	37	53 ^b	43	52 ^c	40	19 ^e	30
13	59	(95,16)	41	53 ^c	45	59 ^b	29	36	38
22	21	(92)	13	8	16	10	13	10	18 ^c
24	48	(15,16)	41	34	46 ^c	48 ^b	48 ^b	25	38
25	57	(16)	46	56 ^c	53	57 ^b	45	34	39
26	59	(95)	42	49	57 ^c	52	34	33	34
27				47	53	52			
28				60	70 ^d	53			
31	56	(15,16)	48	42	52	56 ^b	56 ^b	40	36
41	50	(95)	34	46	49 ^c	46	23	24	26
44	48	(16)	40	39	41	48 ^b	35	38	40
46				39	40	47			
47				38	43	50			
45	44	(17)	37	29	44 ^b	40 ^c	36	36	32
51	46	(16)	38	21	41 ^c	46 ^b	33	32	39
Quota	50	(16)	41	38	46 ^c	50 ^b	39	33	37
11 ^f			18	25	17	28	20	9	15
10 ^f			9	9	8	9	7	7	12
52 ^f			17	10	14	19	15	16	19
No Quota	32	(95)	18	15	15	21	16	13	17
Statewide	40	(95)	29	27	31	37 ^c	28	25	28

^a Registered harvest/licenses instead of harvest/hunters because BMU-year-specific estimates for the proportion of license-holders that hunted are unreliable. Statewide estimates of harvest/hunters are presented in Table 1.

^b Record high (or tied record high) success.

^c Second highest success.

^d Highest success ever for any BMU.

^e Tied record lowest success.

^f Since 2013, an attempt was made to differentiate the number of no-quota (NQ) hunters by BMU in order to estimate success rates. When no-quota hunters bought licenses, they recorded the deer block where they anticipated hunting. A significant number chose blocks in the quota zone; those who did not harvest a bear in the quota zone were divided up into NQ-BMUs in proportion to those who chose blocks in or adjacent to NQ-BMUs. A few chose BMU 60 (SE Minnesota); the first bear was harvested there in 2017. Table shows % indicating where they planned to hunt (number of hunters in parentheses for BMU 60 and Quota zone):

BMU	2018	2017	2016	2015	2014	2013
11	34.6	29.8	30.3	29.3	28.5	30.0
10	7.4	6.6	4.9	4.4	4.1	2.6
52	55.3	59.2	61.2	63.9	64.7	62.6
60 (n)	0.1 (4)	0.1 (4)	0.4 (12)	0.2 (8)	0.6 (17)	0.4 (10)
Quota zone (n)	2.6 (83)	4.2 (137)	3.2 (105)	3.1 (101)	2.1 (60)	4.5 (127)

Table 7. Cumulative bear harvest (% of total harvest) by date, 1998–2018.

Year	Day of week for opener	Aug 22/23 – Aug 31	Sep 1 – Sep 7	Sep 1 – Sep 14	Sep 1 – Sep 30
1998	Tue		76	87	96
1999	Wed		69	81	95
2000	Wed	57	72	82	96
2001	Wed	67	82	88	98
2002	Sun		57 ^a	69 ^a	90
2003	Mon		72	84	96
2004	Wed		68	82	95
2005	Thu		72	81	94
2006	Fri		69	83	96
2007	Sat		69	82	96
2008	Mon		58 ^a	71 ^a	92
2009	Tue		74	86	96
2010	Wed		69	84	96
2011	Thu		65	78	93
2012	Sat		68	83	96
2013	Sun		61	76	94
2014	Mon		60	75	92
2015	Tue		58 ^b	75	91
2016	Thu		68	83	95
2017	Fri		69	83	93
2018	Sat		59 ^a	75	91

^a The low proportion of total harvest taken during the opening week (<60%) reflects a high abundance of natural foods.

^b The slow start the first week was likely due to especially warm weather.

Table 8. Number of nuisance bear complaints registered by Conservation Officers and Wildlife Managers during 1998–2018, including number of nuisance bears killed and translocated, and bears killed in vehicular collisions.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 ^j	2018 ^j
Number of personnel participating in survey ^a	71	52	60	54	50	39	34	42	46	46	37	51	40	34	56	63	64	61	55	86 (51,35)	78 (56,23)
Complaints examined on site	226	189	105	122	75	81	75	61	57	63	59	65	70	37	113	69	79	97	118	71 (22,49)	40 (21,19)
Complaints handled by phone ^b	743	987	618	660	550	424	507	451	426	380	452	535	514	396	722	623	570	840	780	644 (450,194)	438 (369,69)
Total complaints received	969	1176	723	782	625	505	582	512	483	443	511	600	584	433	835	692	649	937	898	715	478
• % Handled by phone	77%	84%	85%	84%	88%	84%	87%	88%	88%	86%	88%	89%	88%	91%	86%	90%	88%	90%	87%	90%	92%
Bears killed by:																					
• Private party or DNR	31	25	25	22	12	13	25	28	11	21	22	23	22	9 ^k	16	24	26	45	53	22 (4, 18)	9 ^k (4,5)
• Hunter before season ^c																					
– from nuisance survey	23	5	7	4	0	3	3	6	2	18	3	4	3	3	11	0	0	1	13	1	2
– from registration file	31	24	43	20	11	8	4	13	6	25	5	15	10	5	12	0	1	4	6	3	11 ^m
• Hunter during/after season ^d	3	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0
• Hunter by Area 88 license ^e																				1	^m
• Permittee ^f	11	7	2	6	4	6	1	5	4	5	1	3	5	0	0	1	0	3	0	0	1

Table 8. (continued)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bears translocated	24	29	1	6	3	1	3	3	3	1	3	2	2	2	0	3	2	0	0	0	0
• % bears translocated ^g	11	15	1	5	4	1	4	5	5	2	5	3	3	5	0	4	3	0	0	0	0
Bears killed by cars ^h	61	60	39	43	26	25	16	22	18	20	27	18	28	15	33	32	28	47 ^h	27	9 (0,9) ^h	25 (15,10) ^h

^a Maximum number of people turning in a nuisance bear report each month. Monthly reports were required beginning in 1984, and included cases of zero complaints. In 2017, the recording system was changed, where Wildlife Managers only recorded actual complaints (not zero complaints). Since then, the number reflects the total number of people receiving and recording at least 1 complaint during that year. For consistency, the records from Conservation Officers were handled the same way.

^b If a complaint was handled by phone, it means a site visit was not made.

^c The discrepancy between the number recorded on the nuisance survey and the number registered before the opening of the season indicates incomplete data. Similarity between the two values does not necessarily mean the same bears were reported.

^d Data only from nuisance survey because registration data do not indicate whether bear was a nuisance.

^e In 2017, hunters could choose Area 88 in the quota lottery, and if drawn, could hunt for a nuisance bear, if authorized (11 were authorized, 1 killed a bear). In 2018, Area 88 was only a designation for hunters willing to take a nuisance bear in the quota area on a no-quota license, if so authorized; 116 hunters were on this list. However, none of the 4 hunters with NQ licenses who killed a bear in the quota area (Table 5) were authorized to do so. It is not known from these records if others were authorized but did not kill a bear.

^f A permit for non-landowners to take a nuisance bear before the bear season was officially implemented in 1992, but some COs individually implemented this program in 1991. Data are based on records from the nuisance survey, not directly from permit receipts. Only 5 bears have been killed by permittees since 2011.

^g Percent of on-site investigations resulting in a bear being captured and translocated. According to DNR nuisance policy, trapped nuisance bears should not be translocated.

^h Car kill data were reported on the monthly nuisance form beginning in 2005. In all previous years, car kill data were from Enforcement's confiscation records. In 2015, confiscation records had more car-kills than the nuisance survey (47 vs 33), so the higher number is shown here. In 2017, only 1 car-kill was in the confiscation records, and in 2018 there were just 2. In 2017, the electronic system used by managers did not allow for recording of car kills. In 2018, an effort was made to increase car-kill reporting by managers (although still just recorded in comments).

^j Beginning in 2017, Wildlife Managers recorded nuisance bear complaints on an all-species wildlife damage app, whereas Conservation Officers continued to submit monthly nuisance bear survey forms (April–Oct). The 2 survey tools are not exactly the same, so data are presented separately for each in parenthesis (Wildlife Managers, COs). For consistency, only April–October data are included (in 2017 managers recorded 10 calls in other months, in 2018 14 calls were in other months).

^k Lowest number of nuisance bears were killed in 2011 and 2018, since recording began in 1982.

^m 9 of the 11 pre-season hunters in 2018 were in BMU 11. None were NQ hunters authorized to hunt in the quota zone (Area 88).

Fig. 5. Trends in nuisance bear complaints, and nuisance bears killed and moved, 1981–2018, showing dramatic effect of change in nuisance bear policy, and slight increasing trend over past decade, until 2018.

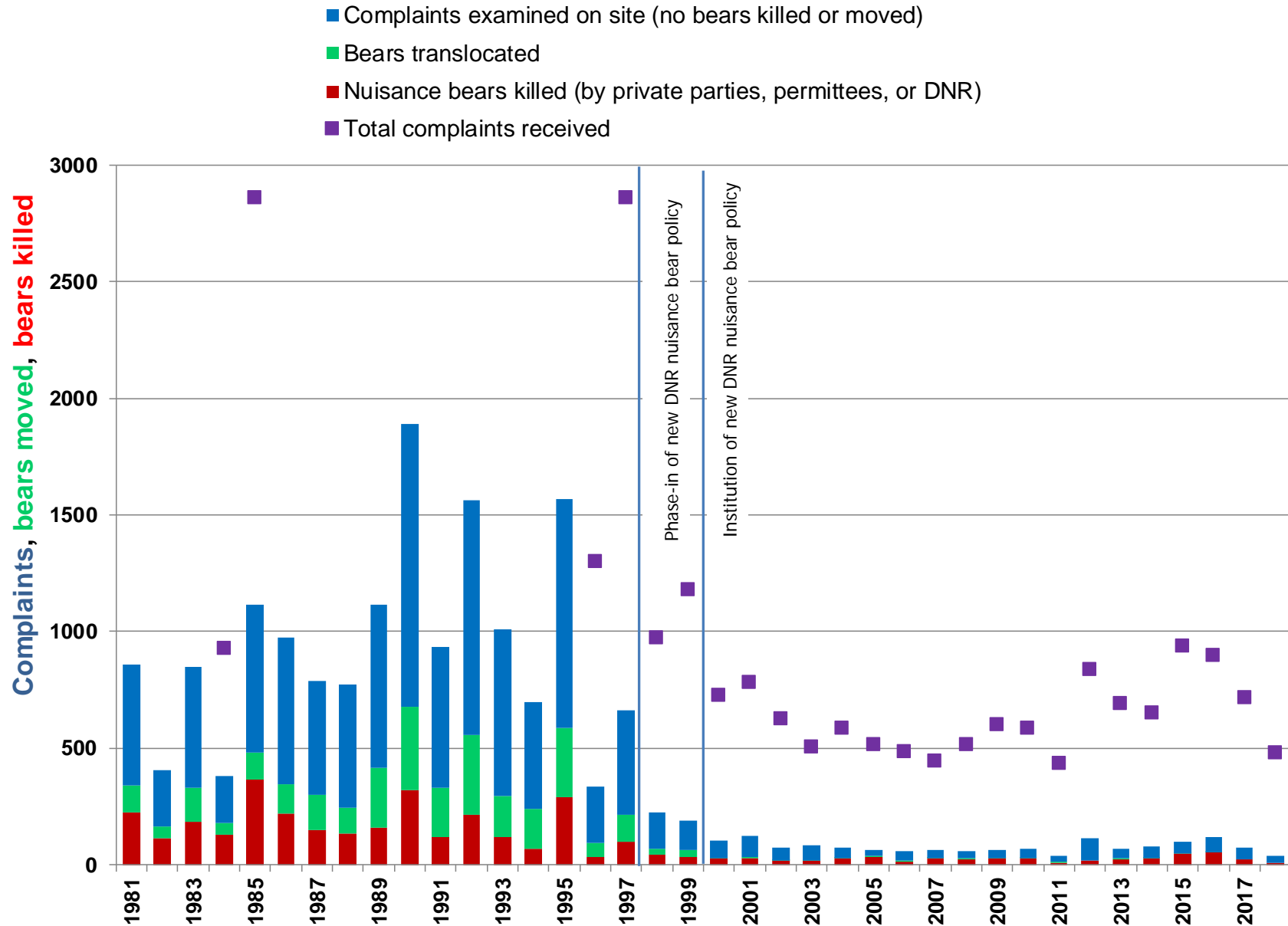
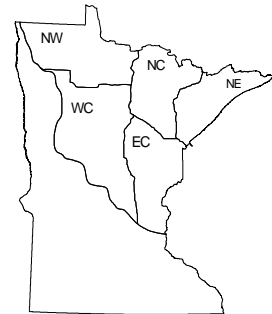


Table 9. Regional bear food indices^a in Minnesota's bear range, 1984–2018. Shaded blocks indicate particularly low (<45; pink) or high (≥70; green) values.

Year	Survey Area					Rangewide
	NW	NC	NE	WC	EC	
1984	32.3	66.8	48.9	51.4	45.4	51.8
1985	43.0	37.5	35.3	43.5	55.5	42.7
1986	83.9	66.0	54.7	74.7	61.1	67.7
1987	62.7	57.3	46.8	67.4	69.0	61.8
1988	51.2	61.1	62.7	54.4	47.3	56.0
1989	55.4	58.8	48.1	47.8	52.9	51.6
1990	29.1	39.4	55.4	44.0	47.9	44.1
1991	59.7	71.2	64.8	72.1	78.9	68.4
1992	52.3	59.9	48.6	48.1	63.3	58.2
1993	59.8	87.8	75.0	73.9	76.8	74.3
1994	68.6	82.3	61.3	81.5	68.2	72.3
1995	33.8	46.5	43.9	42.0	50.9	44.4
1996	89.5	93.2	88.4	92.2	82.1	87.6
1997	58.2	55.5	58.8	62.0	70.1	63.9
1998	56.9	72.8	66.4	72.3	84.5	71.1
1999	63.7	59.9	61.1	63.2	60.6	62.0
2000	57.7	68.0	54.7	69.2	67.4	62.3
2001	40.6	48.7	55.6	62.2	66.0	55.8
2002	53.1	63.4	60.4	68.6	68.3	66.8
2003	59.1	57.5	55.2	58.6	49.7	58.8
2004	57.0	60.5	61.1	70.3	67.9	64.4
2005	53.4	65.9	61.4	59.9	72.6	62.3
2006	51.0	64.9	53.4	51.0	52.1	56.9
2007	68.4	79.0	67.3	67.6	70.0	69.4
2008	58.6	74.1	64.7	66.6	71.4	65.4
2009	59.9	67.8	63.2	69.2	69.5	66.5
2010	70.0	71.3	79.0	60.8	57.3	68.0
2011	61.4	59.6	57.9	66.7	63.5	62.5
2012	49.1	50.3	59.4	50.5	41.5	50.7
2013	71.9	77.1	76.0	59.1	63.2	71.8
2014	71.4	70.7	71.4	61.0	66.5	70.2
2015	47.2	56.3	44.8	57.2	46.5	50.7
2016	79.5	64.3	75.8	64.4	60.6	70.3
2017	67.1	57.5	56.2	70.6	73.9	61.3
2018	72.6	82.4	101.8 ^b	71.5	88.3 ^b	83.9 ^b



^a Each bear food index value represents the sum of the mean index values for 14 species, based on surveys conducted in that area. Range-wide mean is derived directly from all surveys conducted in the state (i.e., not by averaging survey area means).

^b Record high food rating in NE and EC regions, and second-highest statewide.

Table 10. Regional mean index values^a for bear food species in 2018 compared to the previous 34-year mean (1984-2017) in Minnesota's bear range. Shading indicates particularly high (green) or low (pink) fruit abundance relative to average (≥ 1 point difference for individual foods; ≥ 5 points difference for totals).

FRUIT	NW		NC		NE		WC		EC		Rangewide	
	34yr mean	2018 (n = 11 ^b)	34yr mean	2018 (n = 10)	34yr mean	2018 (n = 5)	34yr mean	2018 (n = 7)	34yr mean	2018 (n = 11)	34yr mean	2018 (n = 36)
SUMMER												
Sarsaparilla	4.6	6.5	5.8	7.2	5.3	8.4	4.5	4.0	5.3	6.0	5.0	6.3
Pincherry	3.3	5.1	4.4	6.1	4.2	9.4	3.8	3.8	3.7	5.4	3.9	5.8
Chokecherry	5.7	9.4	5.4	8.8	4.5	9.8	5.4	8.3	4.6	6.8	5.2	8.9
Juneberry	5.2	6.6	4.9	6.7	5.0	8.8	3.7	4.3	3.9	8.4	4.5	6.8
Elderberry	1.6	0.5	3.0	3.2	3.6	4.5	3.1	2.5	3.3	3.6	2.9	2.7
Blueberry	5.1	7.5	5.4	9.9	4.9	8.7	3.6	5.0	3.8	5.2	4.4	7.4
Raspberry	6.4	8.1	7.9	9.0	7.9	12.4	7.1	6.1	7.0	9.2	7.1	8.7
Blackberry	1.3	1.5	2.4	1.0	1.2	1.0	3.6	4.0	4.4	6.9	2.9	3.7
FALL												
Wild Plum	2.2	4.2	1.8	6.1	1.1	6.3	2.7	5.6	2.4	3.0	2.2	4.7
HB Cranberry	5.3	5.3	4.5	4.0	3.9	6.5	3.8	2.6	3.8	4.6	4.2	4.3
Dogwood	6.2	7.0	5.7	5.1	4.9	6.3	5.9	7.7	5.9	6.6	5.7	6.8
Oak	3.5	3.1	3.1	3.3	1.9	4.3	5.8	9.0	5.6	8.7	4.4	6.4
Mountain Ash	1.6	1.5	2.5	4.4	2.5	7.3	1.7	1.3	2.3	4.1	2.6	3.7
Hazel	6.3	6.2	7.3	7.4	7.3	8.2	7.9	7.3	7.6	9.8	7.2	7.7
TOTAL	58.3	72.6	64.1	82.4	58.2	101.8	62.6	71.5	63.4	88.3	62.3	83.9

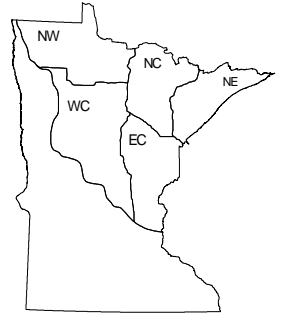
^a Food abundance indices were calculated by multiplying species abundance ratings x fruit production ratings.

^b n = Number of surveys used to calculate area-specific means

^c Sample size for the entire range does not equal the sum of the sample sizes of 5 survey areas because some surveys were conducted on the border of 2 or more areas and were included in calculations for both.

Table 11. Regional productivity index^a for important fall bear foods (oak + hazel + dogwood), 1984–2018. Particularly low (≤ 5.0 ; yellow) or high (≥ 8.0 ; tan) values are shaded.

Year	Survey Area					Entire Range
	NW	NC	NE	WC	EC	
1984	4.2	7.6	7.0	6.2	7.0	6.5
1985	4.9	2.8 ^b	4.2	4.7	5.3	4.4 ^b
1986	7.2	5.0	4.0	7.0	6.2	6.2
1987	8.0	7.8	7.3	7.6	8.0	7.7
1988	5.5	7.2	7.3	6.8	6.1	6.7
1989	6.0	5.3	4.1	5.7	6.4	5.8
1990	3.3 ^b	4.2	6.4	5.7	6.4	5.2
1991	6.2	6.2	5.4	7.2	7.7	6.7
1992	4.7	5.0	4.4	4.4 ^b	6.8	5.1
1993	5.3	7.1	6.7	6.2	7.7	6.5
1994	7.1	7.8	5.8	7.8	7.1	7.2
1995	4.8	4.8	5.1	4.6	5.3	4.9
1996	8.7	8.6	8.1	9.2	8.5	8.6
1997	5.8	5.4	5.1	6.8	6.5	6.2
1998	5.8	6.0	6.3	7.1	7.8	6.7
1999	6.4	5.1	5.9	6.6	6.0	6.2
2000	5.8	7.7	7.2	7.5	8.5	7.0
2001	3.4	4.1	5.7	6.0	6.5	5.2
2002	8.7	7.1	6.6	8.8	8.2	8.1
2003	6.3	6.0	5.5	6.2	6.0	6.1
2004	6.1	5.4	5.4	6.4	6.1	5.9
2005	5.8	5.8	6.1	6.4	7.0	6.2
2006	6.7	6.1	6.0	6.7	5.8	6.3
2007	6.0	5.8	5.7	6.6	6.4	6.2
2008	6.6	7.3	6.2	7.0	8.9	7.1
2009	5.1	6.2	5.3	6.3	6.5	6.0
2010	7.7	6.4	6.5	6.2	5.4	6.6
2011	5.8	6.5	6.2	7.0	7.4	6.5
2012	6.2	6.3	6.3	6.5	4.8	6.1
2013	6.8	6.0	5.7	6.7	6.9	6.3
2014	7.0	5.6	5.4	7.7	6.1	6.7
2015	5.8	5.9	3.5 ^b	8.2	3.7 ^b	5.6
2016	5.7	5.2	6.0	5.4	5.2	5.3
2017	6.8	5.6	5.1	7.4	7.1	6.5
2018	5.8	6.1	7.7	8.3	8.4	7.2



^a Values represent the sum of mean production scores for hazel, oak, and dogwood, derived from surveys conducted in each survey area. Range-wide mean is for all surveys conducted in the state (i.e. not an average of survey area means).

^b Record low fall food score in survey area.

Fig 6. Production of fall bear foods (dogwood, oak, hazel) across Minnesota, 2018.

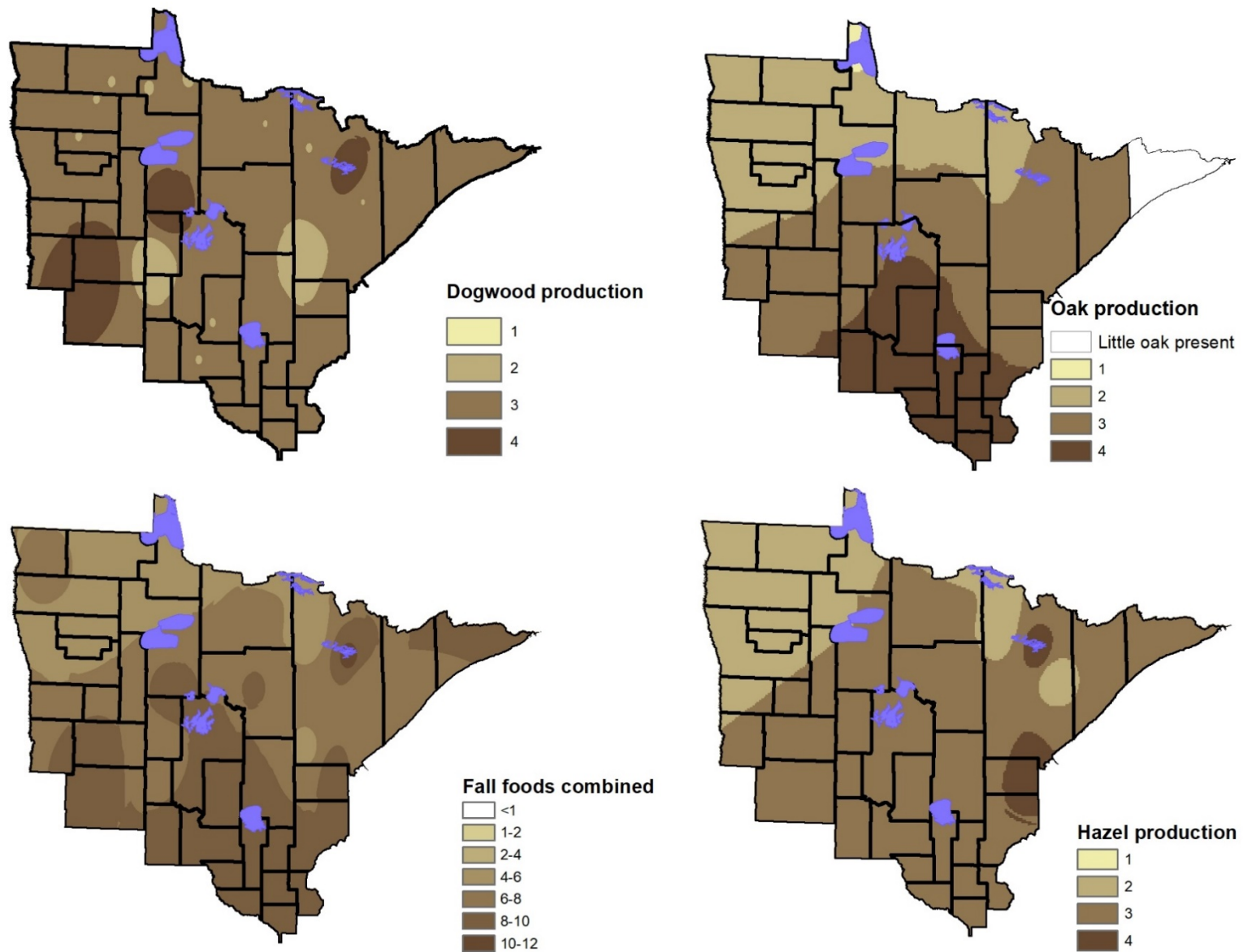


Fig. 7. Number of bears harvested vs. number predicted to be harvested based on number of hunters and fall food production — top panel: statewide 1984–2018; bottom panel: quota zone only, most recent 15 years. Regression for both datasets included an interaction term between food and hunters to better predict the drastic changes in harvest when fall foods were extremely high or low.

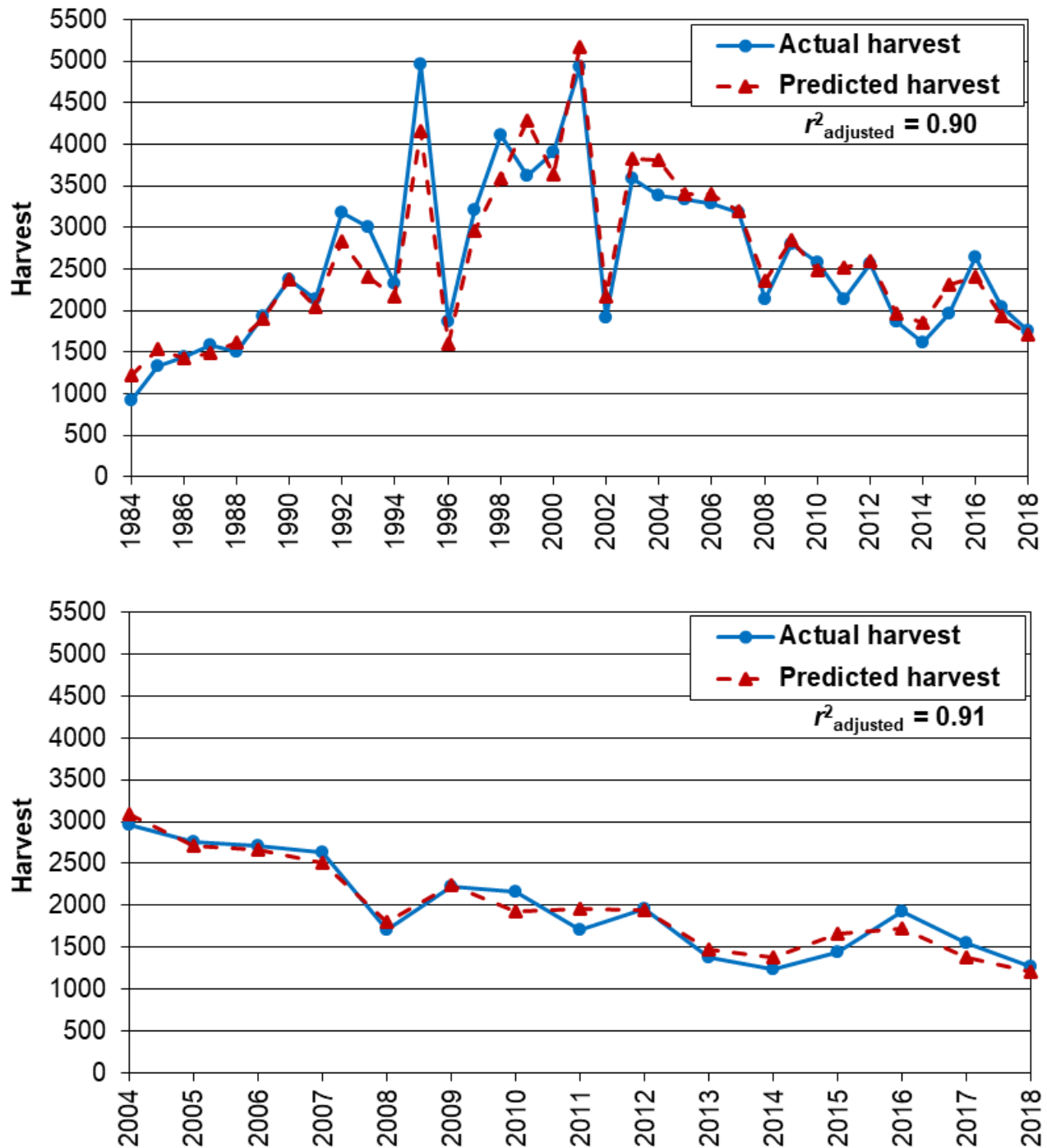


Fig 8. Sex ratios of harvested bears by BMU, 1998–2018. Thick lines show increasing trend across this period.

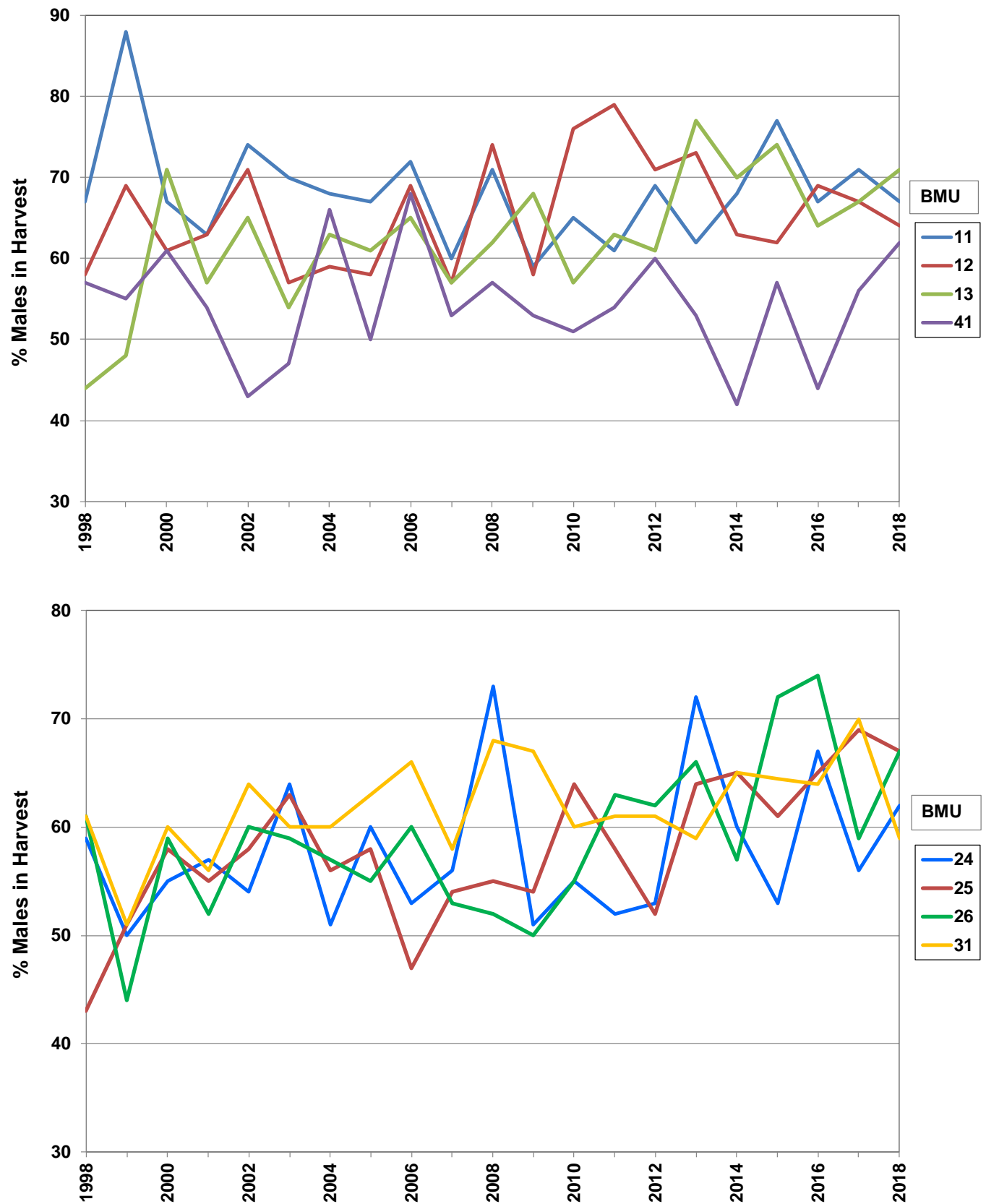


Fig 8. (continued)

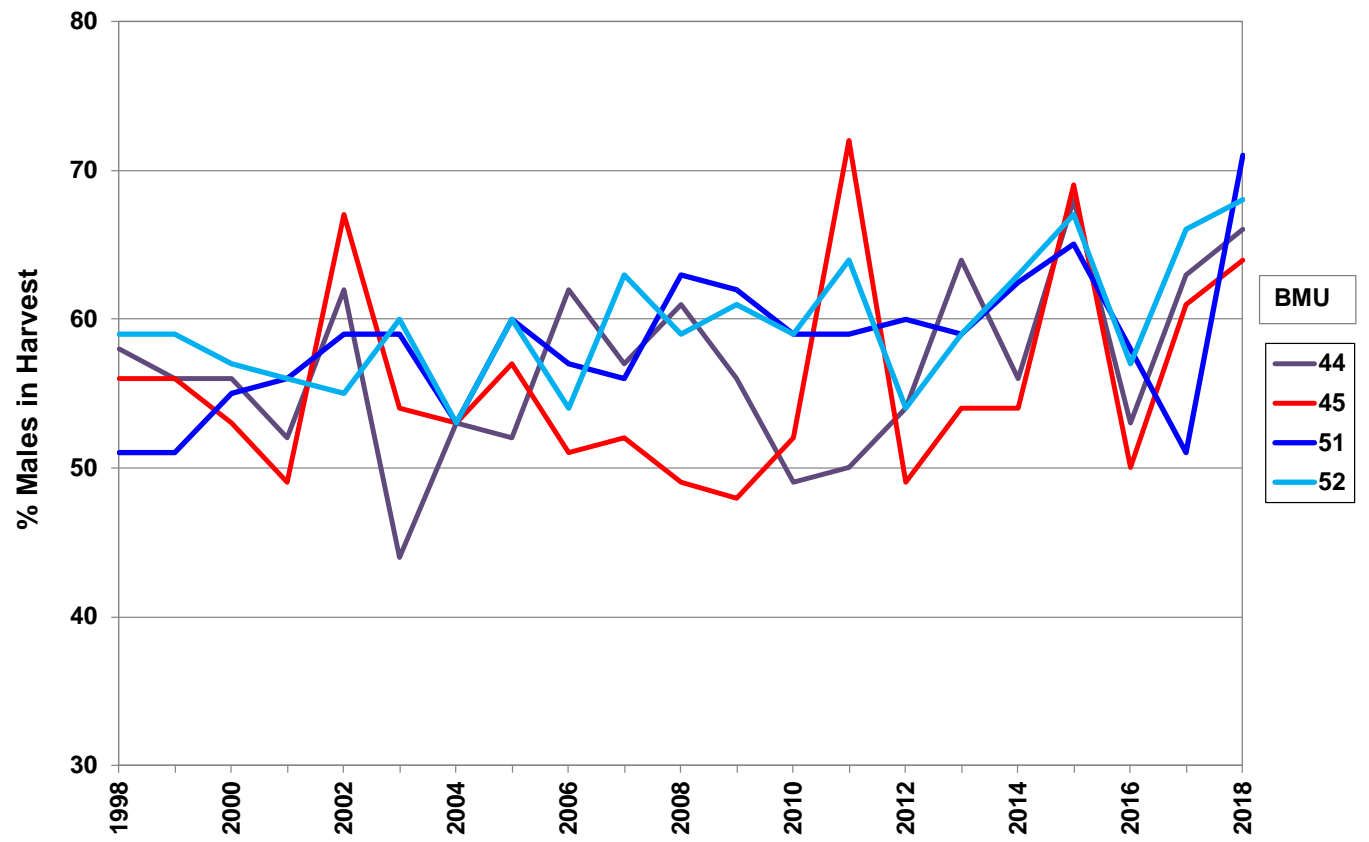


Fig 9. Median ages of harvested female bears by BMU, 1998–2018. Thick lines show decreasing trends across this period. Breaks in line occur when sample sizes were too small to calculate a meaningful median.

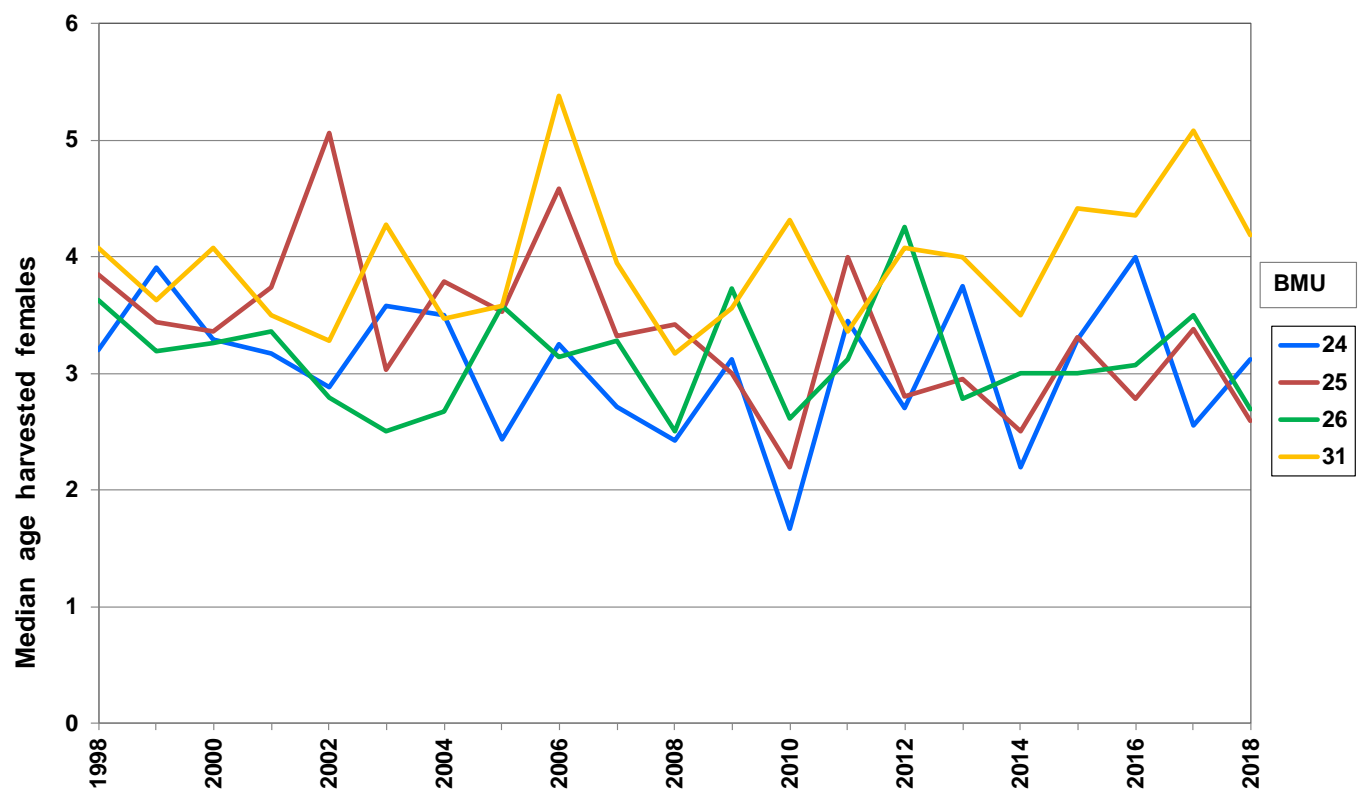
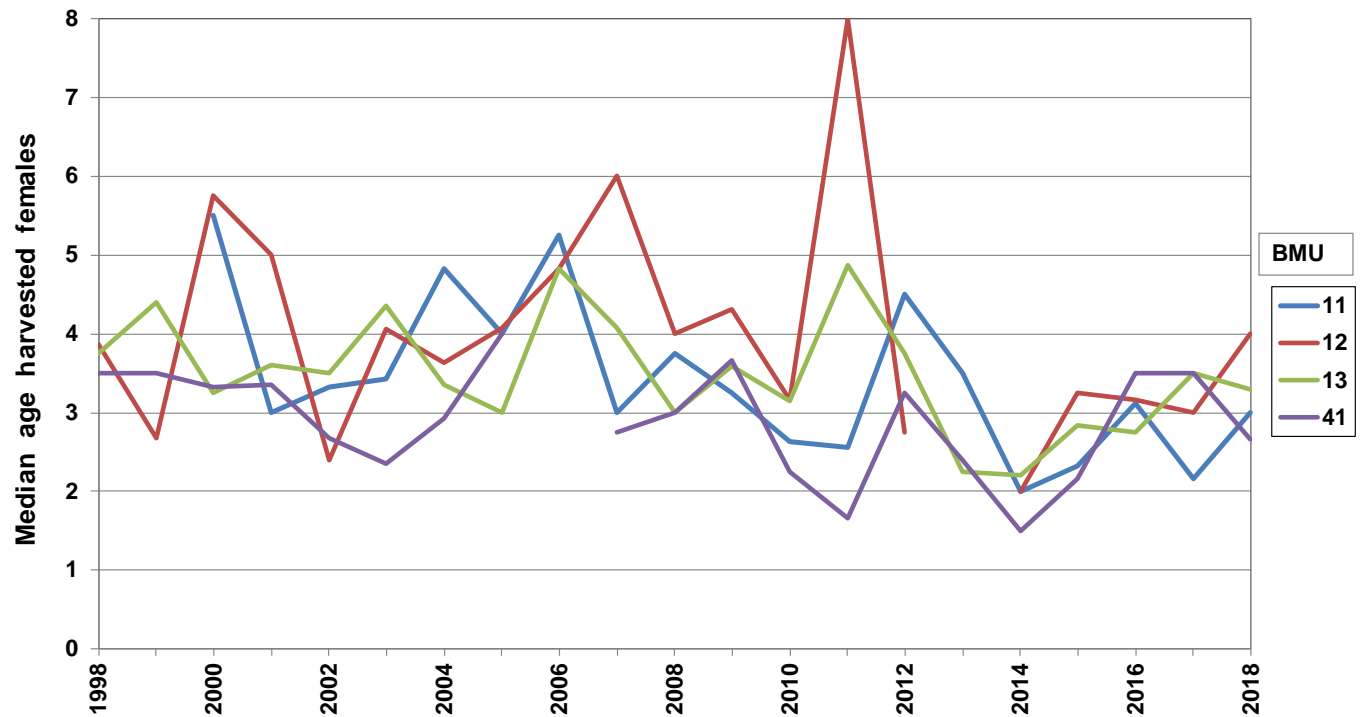


Fig 9. (continued)

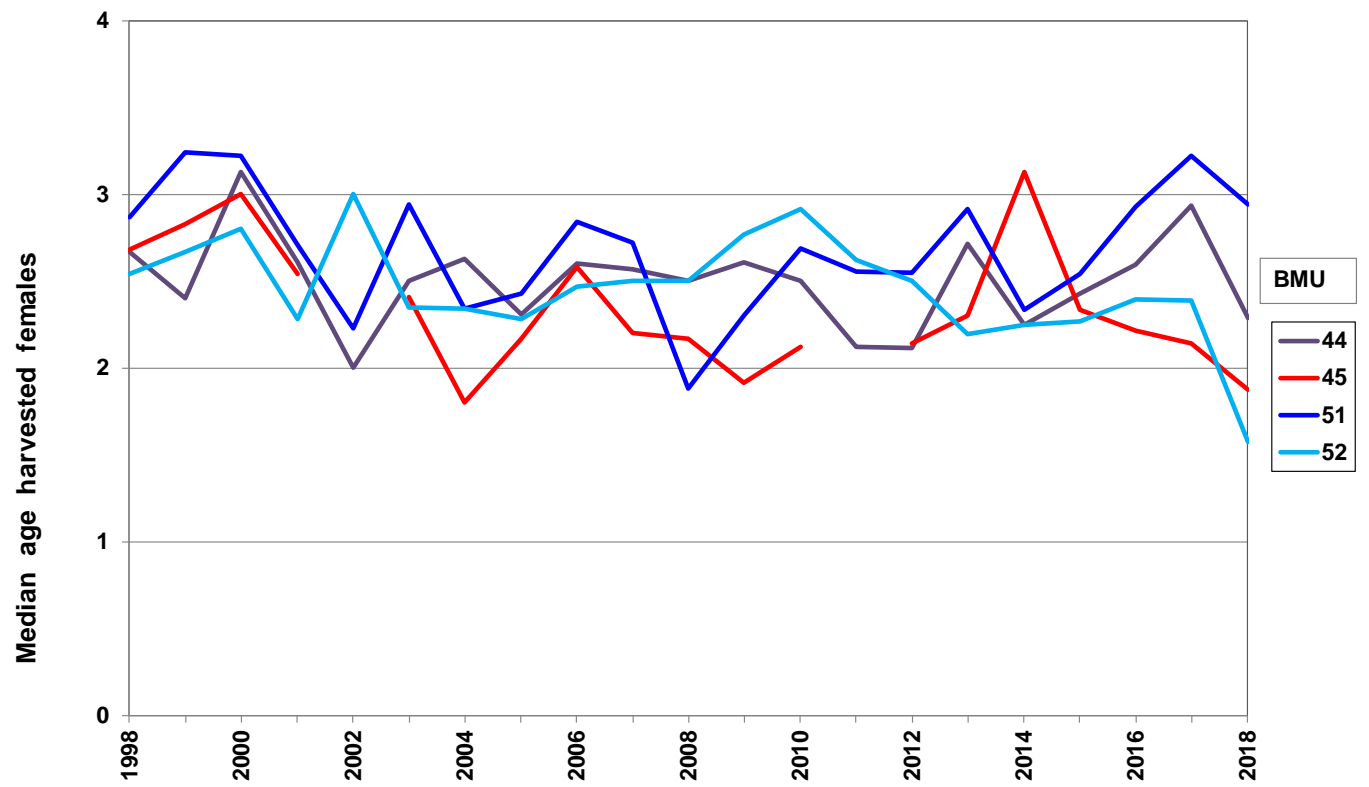


Fig. 10. Statewide median ages (years) and sex ratio of harvested bears, 1982–2018.

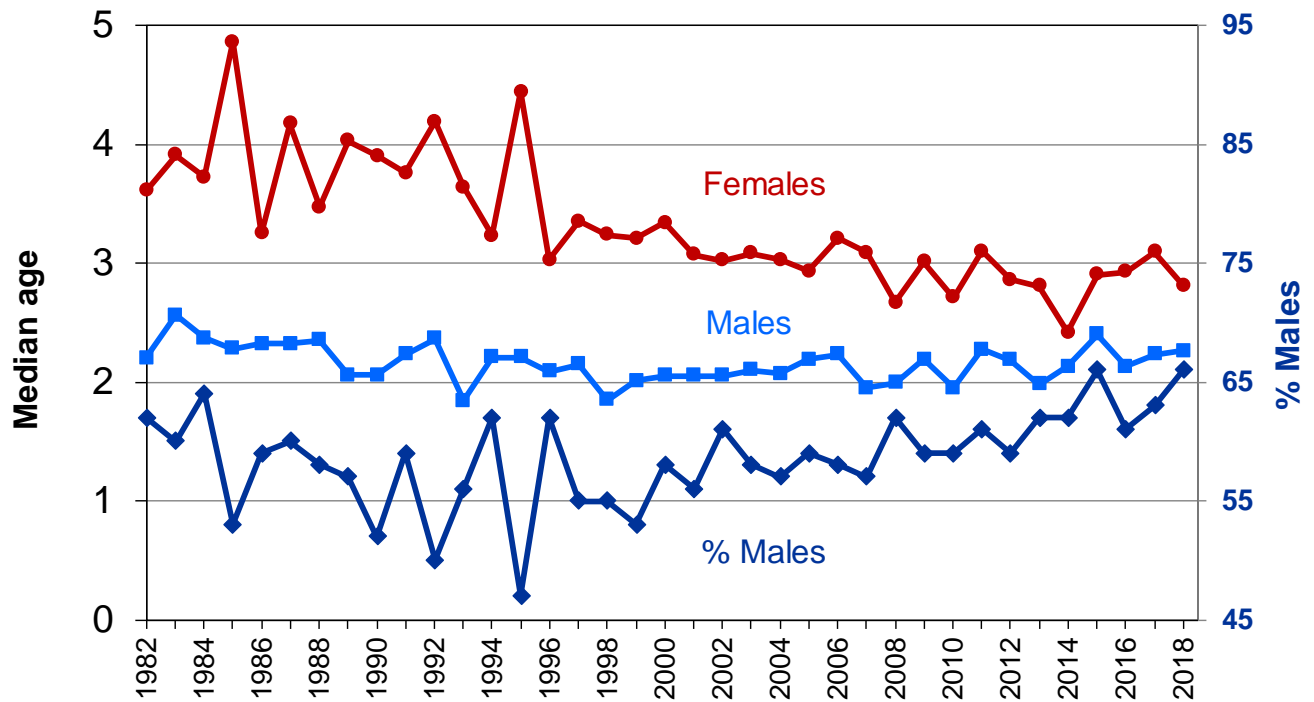


Fig. 11. Statewide harvest structure: proportion of each sex in age category, 1982–2018. Trend lines shown are significant, but since 2008 the trend is level.

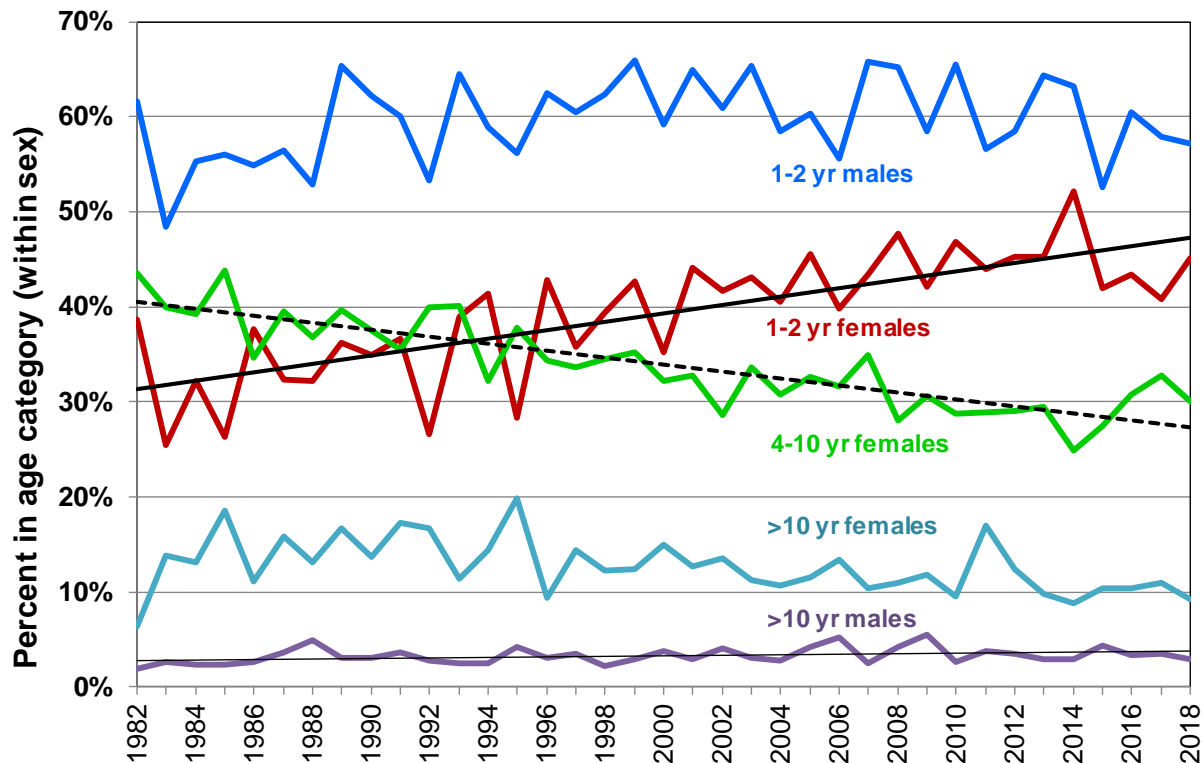


Fig. 12. Percent of hunters submitting useable bear teeth for aging (vital for population monitoring, see Figs. 14–16). Cooperation levels exceeded 80% when registration stations were paid to extract teeth (this practice ended in 1993), and in recent years after a series of reminder letters (no letter was sent in 2018).

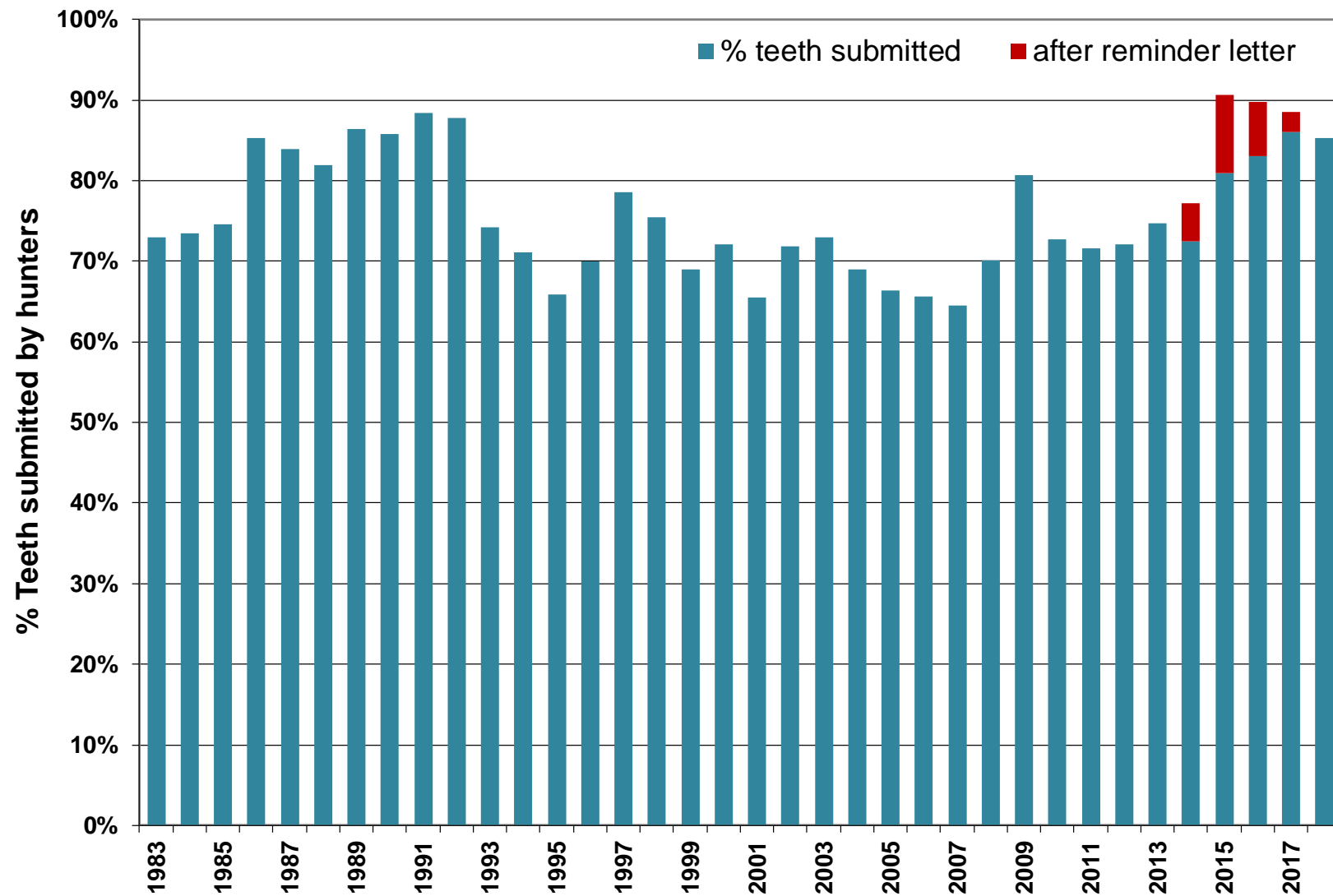


Fig. 13. Percent of hunters who submitted a bear tooth in 2018 by method of registration (top panel) and by BMU (bottom panel). Beginning in 2013, hunters could register their bear by phone or internet, as well as in person at a station.

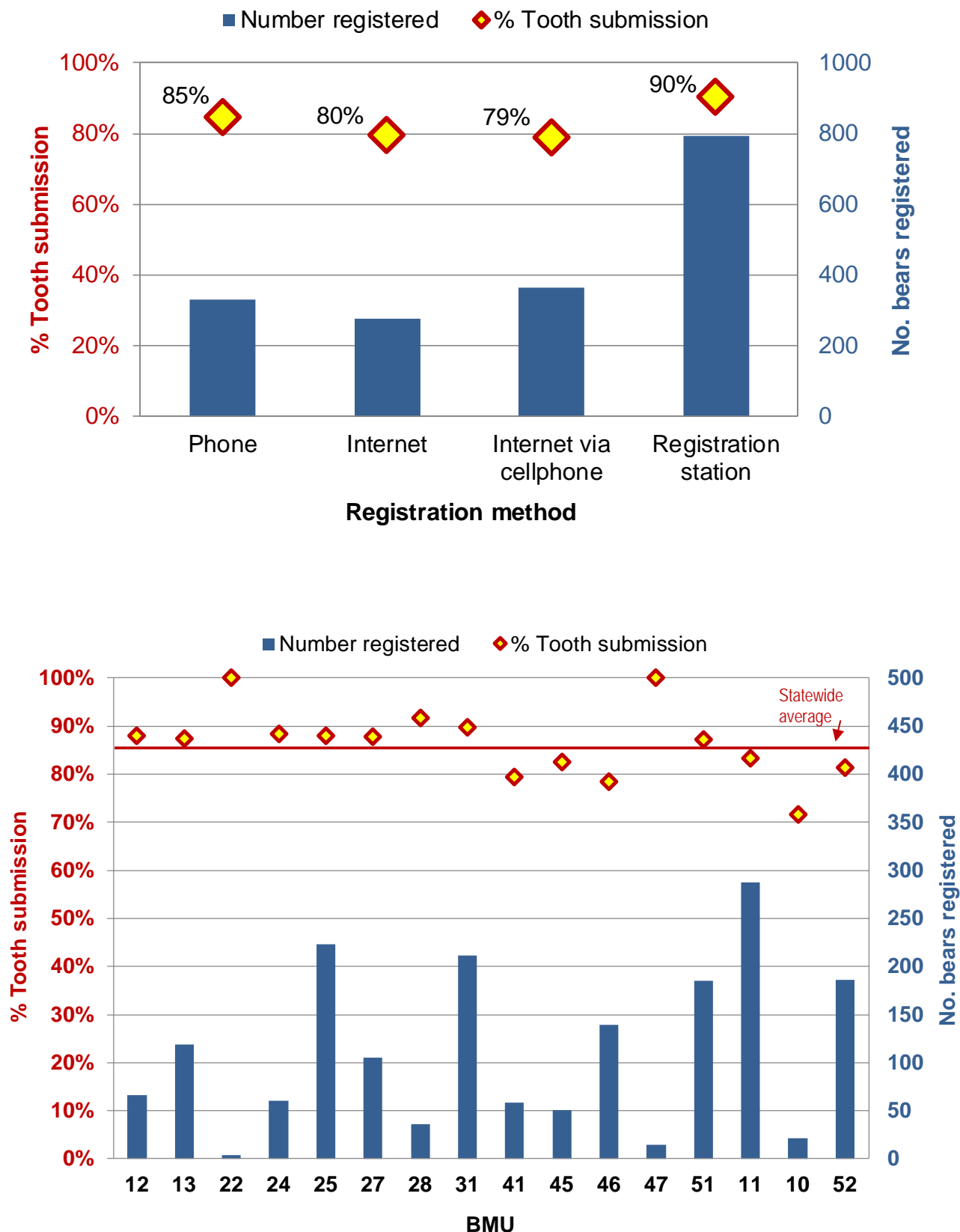


Fig. 14. Statewide bear population trend (pre-hunt) derived from 2 population models: (1) Downing reconstruction, based solely on sex-specific harvest age structures, scaled (elevated to account for non-harvest mortality) to various degrees to attempt to match the tetracycline-based mark–recapture estimates (2 such curves shown here; estimates beyond 2016 are unreliable); and (2) a new Bayesian population model by Allen et al. (2018), which, besides harvest data includes estimates of reproduction and survival as well as an initial population size, and allows for estimates of the current year.

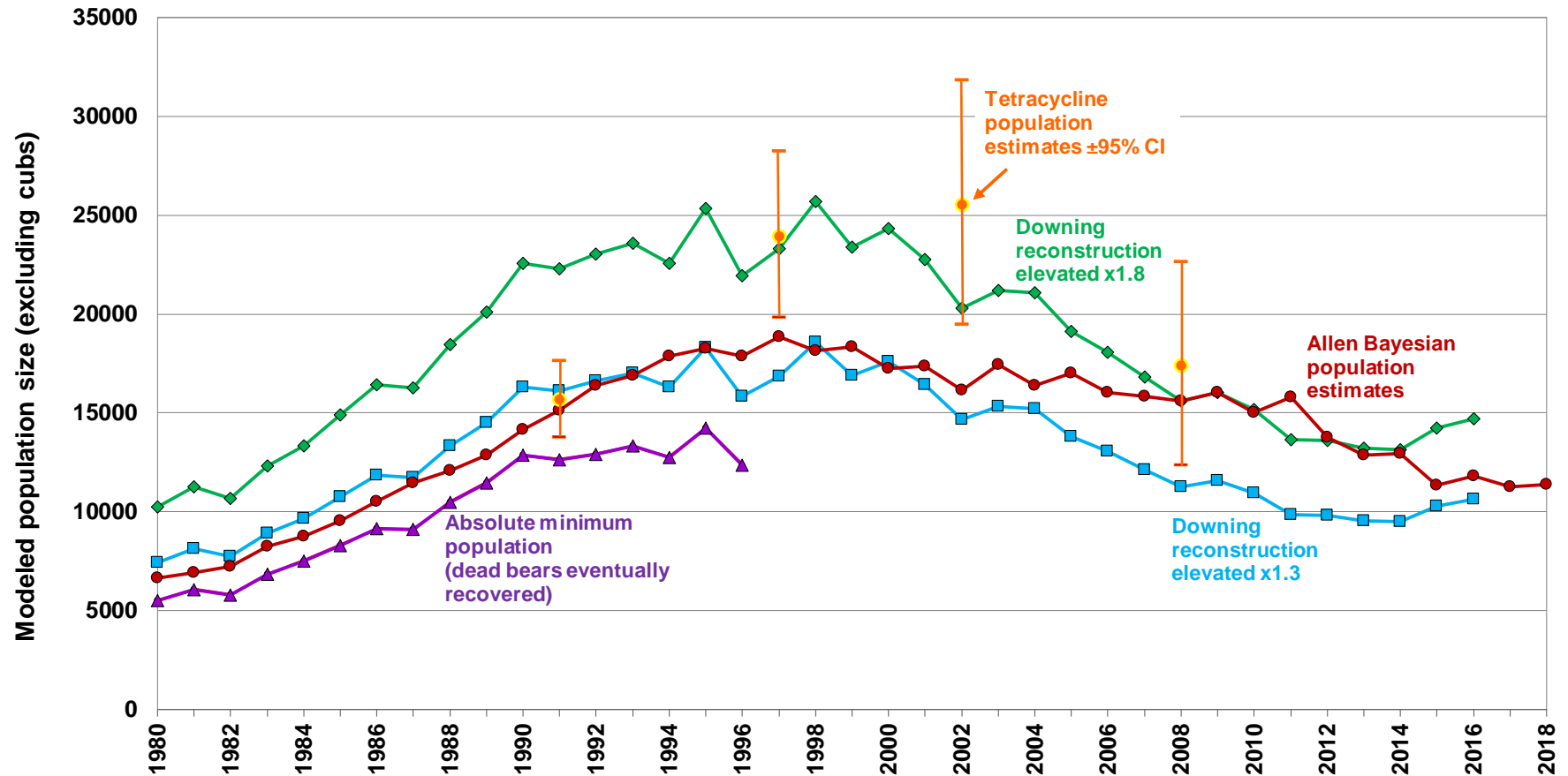


Fig. 15. Population trends during 2000s derived from Downing reconstruction for quota and no-quota zones compared to respective harvests. Reconstruction-based estimates <2 years from the most recent harvest age data are unreliable (hence curves terminate in pre-hunt 2016). Population curves were scaled (elevated to account for non-harvest mortality) to fall between the 2 Downing curves in Fig. 14 (i.e., the actual scale of the population estimates is not empirically-based).

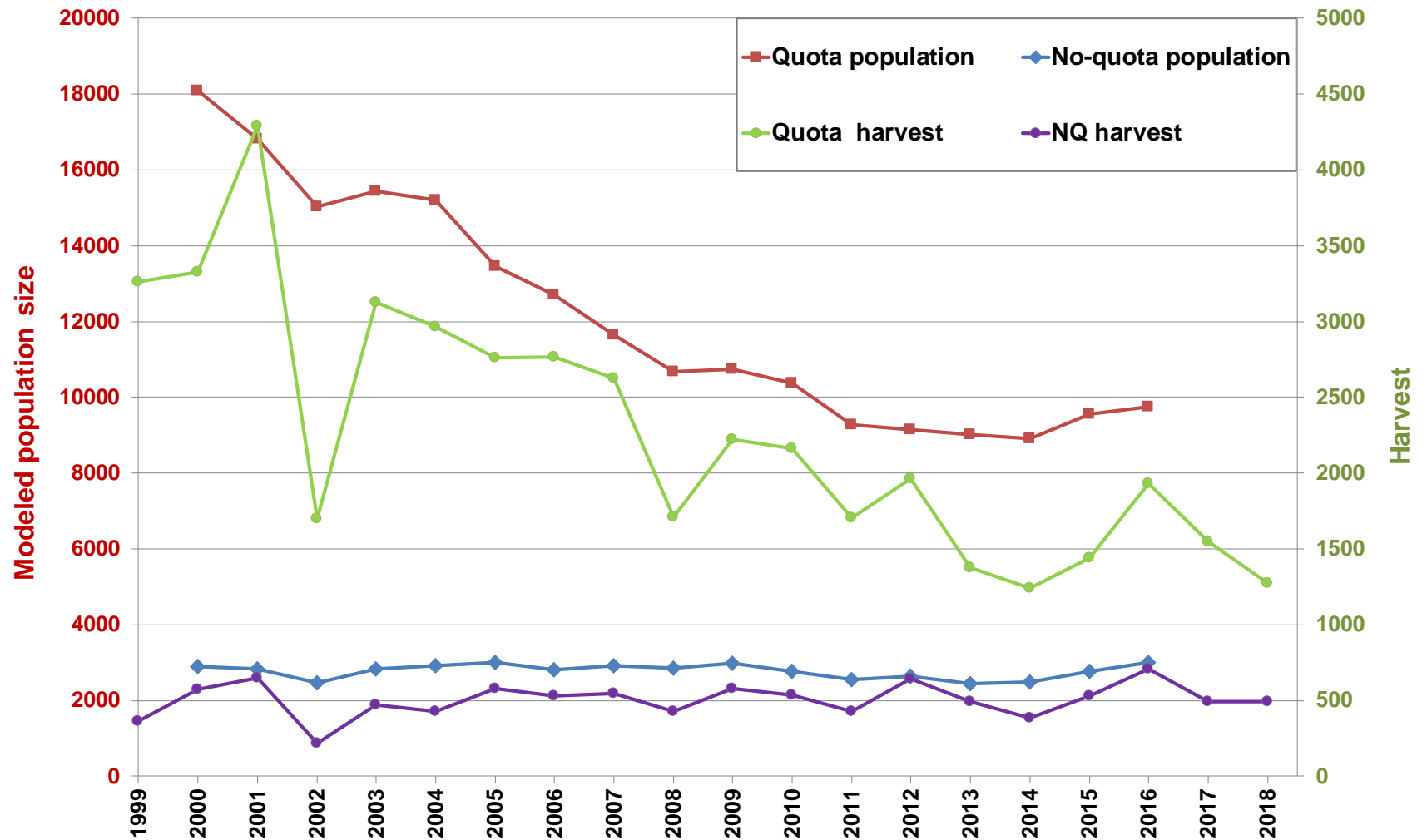


Fig. 16. Trends in proportion of male bears in statewide harvest at each age, 1–10 years, grouped in 5-year time blocks, 1980–2018 (last interval = 4 years). Higher harvest rates result in steeper curves because males in the living population are reduced faster than females. Fitting a line to the data for each time block and predicting the age at which 50% of the harvest is male (dashed tan line) yields approximately the inverse of the harvest rate (derived rates are shown in inset). Flatter curves in recent years indicate lower harvest rates.

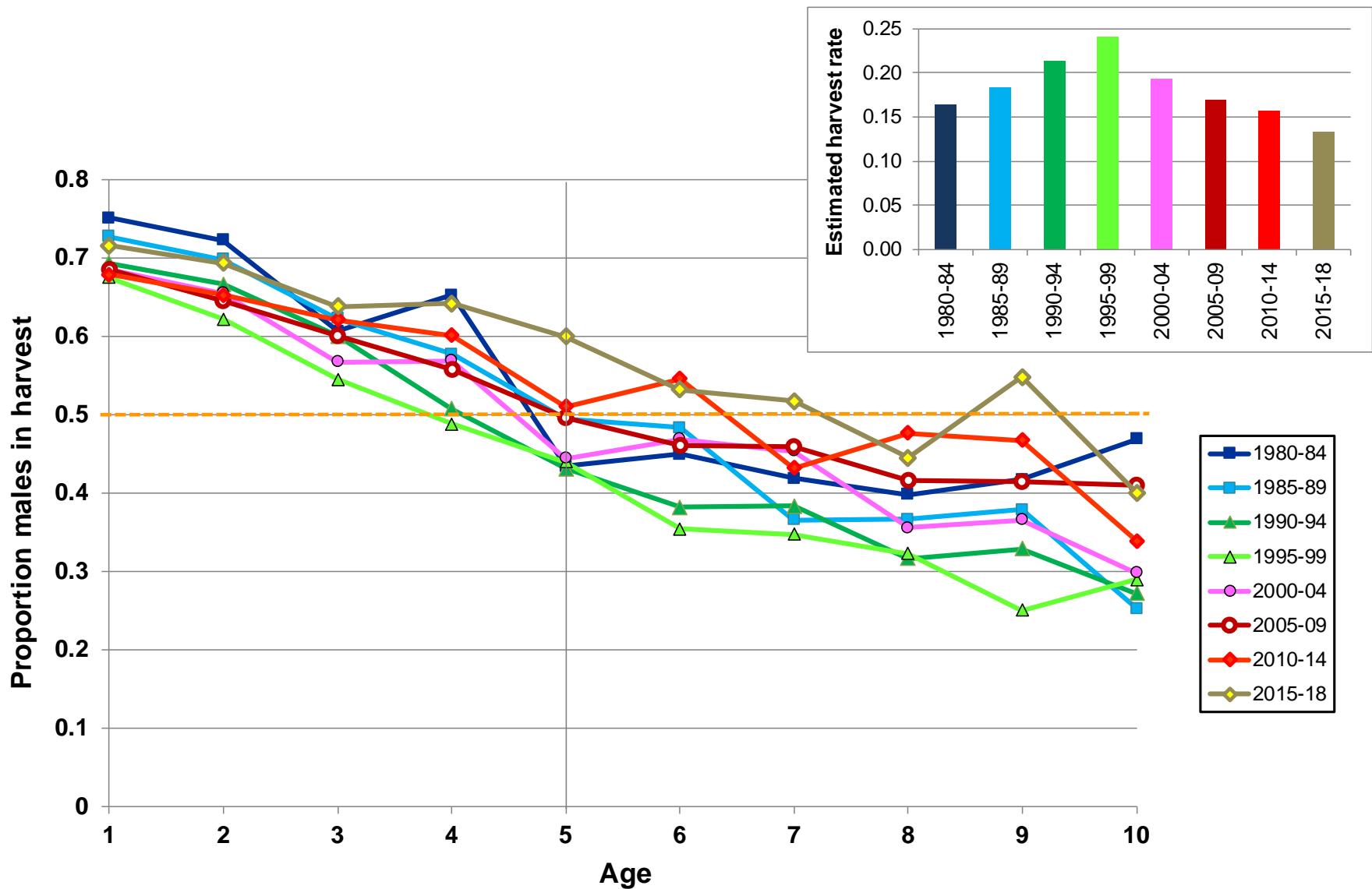


Table 12. Results of 2018 hunter survey versus hunter surveys conducted over the past 30 years, on issues that may relate to hunter selectivity. Blank spaces represent questions not asked in that year (or data not obtainable).

	1988	1991	1998	2001	2009	2018
% 1 st year bear hunter	47%	45%	32%	25%	25%	24%
% >5 years previous bear hunting			18%	21%	35%	36%
% License-holders hunting	91.0%	92.6%	86.8%	93.9%	95.3%	92.7%
Mean days hunted ^a	6.3	6.1	6.3	8.3 ^e	6.8	6.3
% Used bait	74%	78%	82%	92%	89%	91% ^c
Pounds of bait/hunter (median)			100	200	150	150
% Used guide	7%	11%	10%	15%	17%	13%
% Used bow	21%	21%		21%	32%	25%
Bears seen (excl cubs)/hunter-day ^b	0.20	0.22	0.19	0.19		0.23
Bears seen (excl cubs)/hunter			1.1	1.2		1.5 (0–40)
% Passed up shot		73% ^d		70% ^e		37% ^f (42% ^d)
% Used trail camera						83% ^c
Est. no. bears at bait: mean (median)						5 (4)

^a This line and all lines below pertain only to those who hunted.

^b Total bears (excluding cubs) seen by all hunters/total hunter-days (not the mean number of bears seen per hunter-day for individual hunters).

^c Excluding guided hunts. Used bait: Quota zone 95%, No-quota 84%. Used trail camera: Quota zone 87%, No-quota 78%.

^d Calculated as: % hunters seeing more bears than they shot (among hunters seeing at least 1 bear).

^e Hunters could kill 2 bears on 1 license this year; this was designed to discourage passing up a shot at small bears, and allow continued hunting (hence unusually high number of days hunted). Nevertheless, only 30% of hunters said they shot at first bear that presented a good shot.

^f % of hunters who said they passed up shooting a legal bear for any reason: 38% in quota zone, 37% in no-quota zone.

Fig. 17. Hunters who indicated they passed up a shot at a legal bear for various reasons, in quota and no-quota zones, based on 2018 hunter survey. The same proportion (61%) of licensed hunters were surveyed in each area, although response rates differed: 55% quota, 40% no-quota.

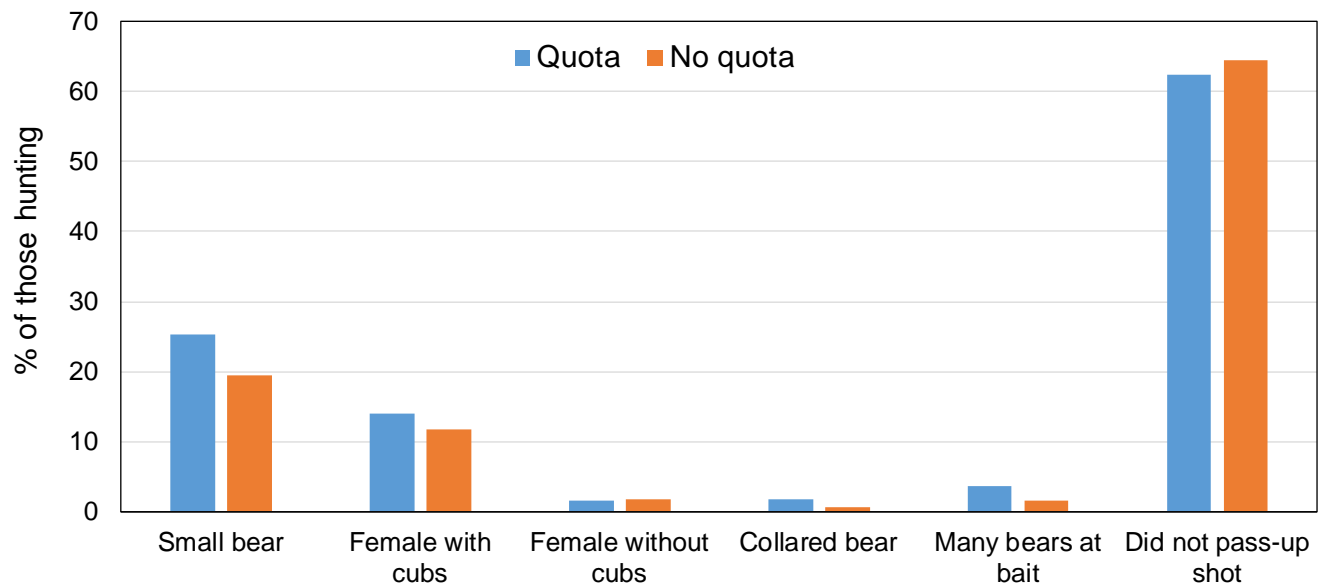


Fig. 18. Hunters' feelings about number of other hunters in their general hunting area, based on 2018 bear hunter survey, comparing quota zone versus BMUs in the no-quota zone.

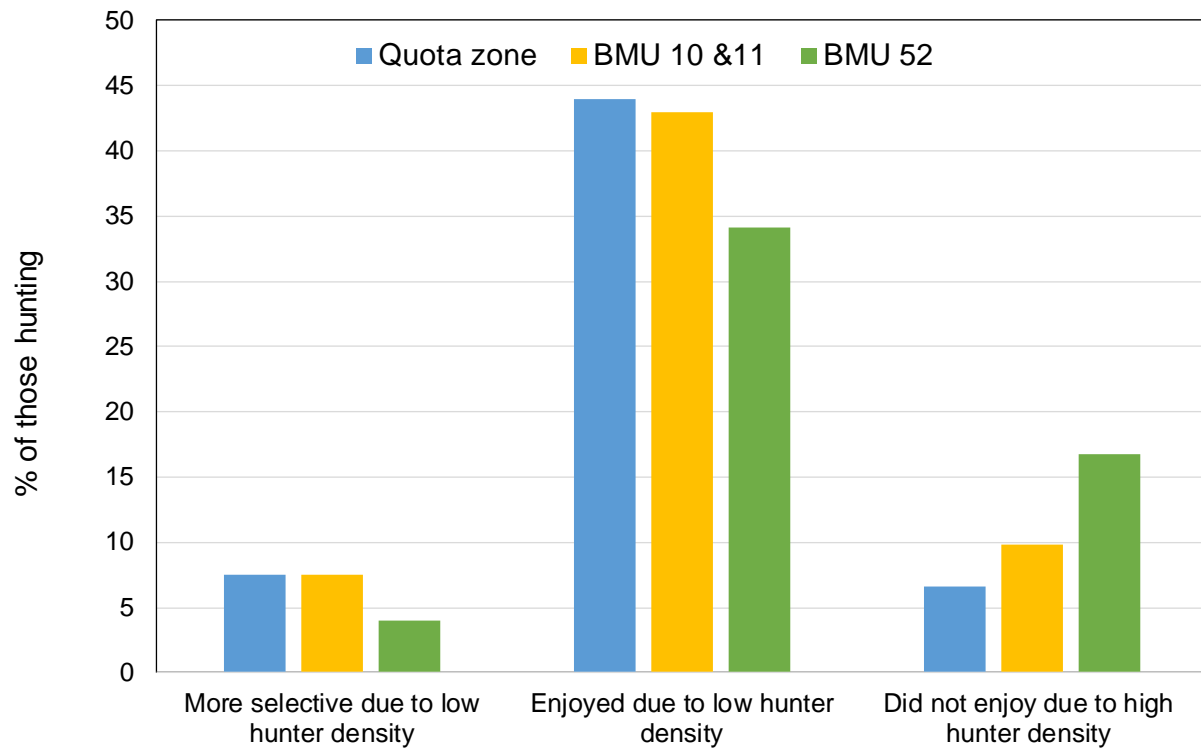


Fig. 19. Opinions and reactions of hunters in quota zone to lower quotas, based on 2018 survey.

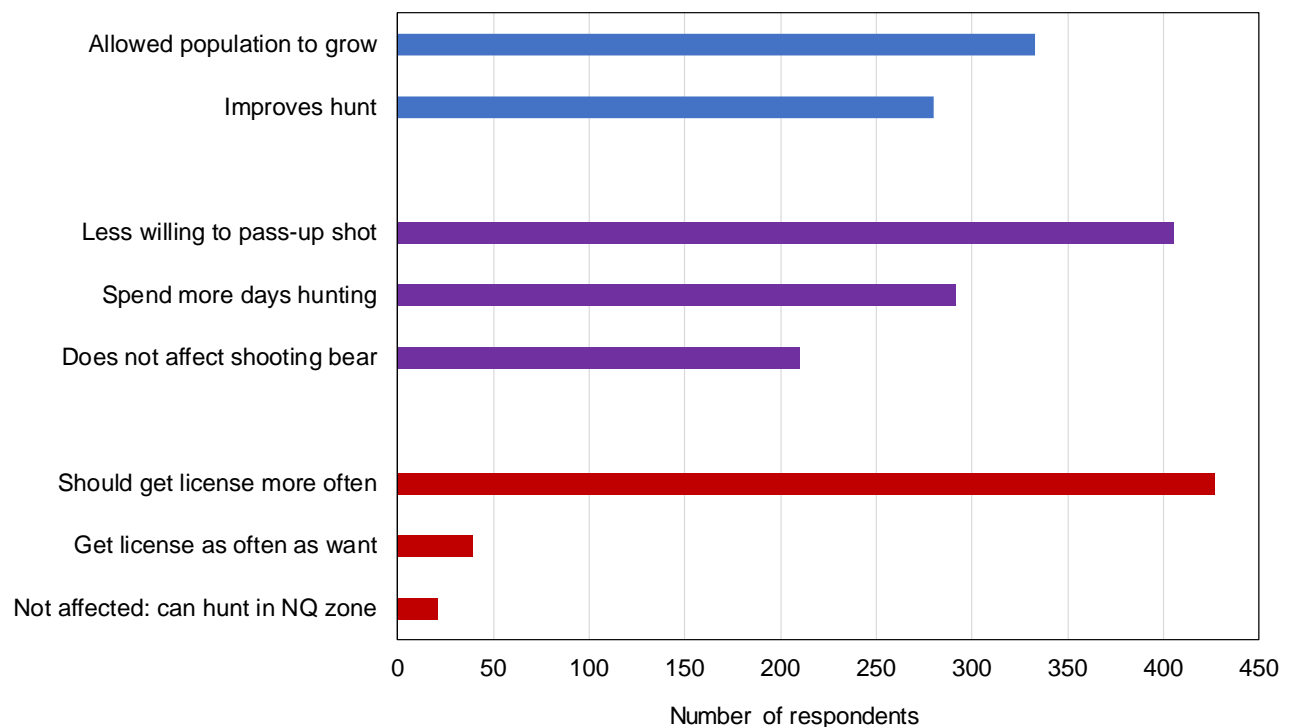


Fig. 20. Opinions of hunters about the status of the bear population in the area where they hunted, based on a 2018 survey.

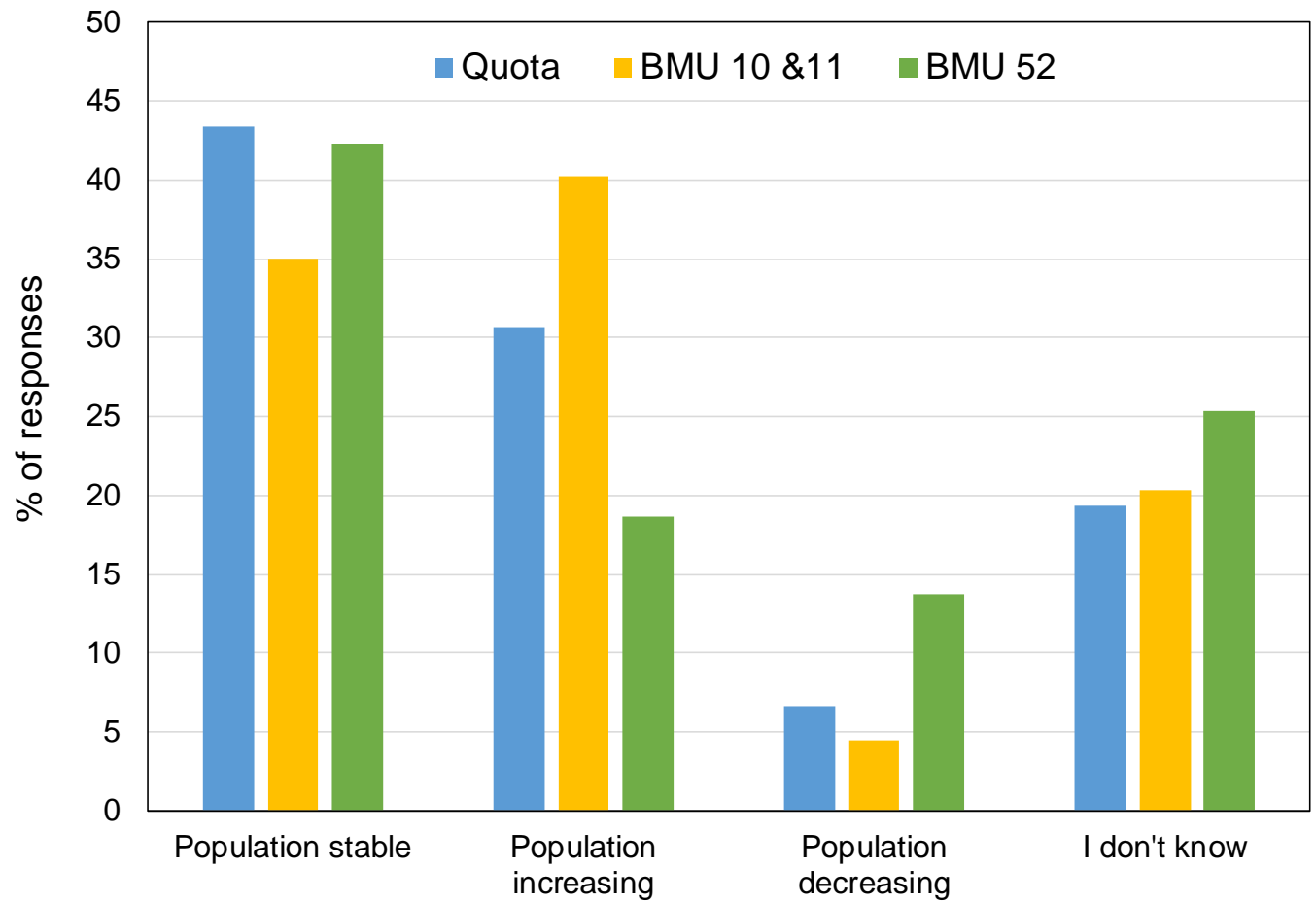


Fig. 21. Percent of hunters in each BMU who consider the population in their hunting area to be increasing, based on a 2018 survey. Percentages exclude hunters who had no opinion of population trend.

