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Weapon Employment Zone (WEZ) Analysis of the
Optimized 300 Winchester Magnum vs 338 Lapua Magnum
With Various Ammunition Types

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Background

The specific intent of this WEZ report is to compare the ballistic performance of the 300 Winchester Magnum to the 338 Lapua Magnum with several available ammunition types. Understanding how these weapons compare in terms of hit percentage is important in the context of modern military applications. The recent upgrade of the M24 to the more modern XM-2010 platform would indicate that the 300 Win Mag is here to stay. **[Ref 4]** Ongoing activity with the Precision Sniper Rifle (PSR) development suggests that a platform based around the 338 Lapua Magnum class cartridge will be an option to consider someday as well. Understanding how these two options compare from a performance/hit percentage point of view, in combination with funding and logistics considerations will aid decisions regarding which platform to supply in various units and theaters.

Ammo Types

ABWEZDOC102 **[Ref 2]** provided a complete characterization of the 300 Win Mag, XM-2010 configuration including: A191, MK248 Mod1, and the Berger 230 OTM ammo types. Hit percentage was determined for these 3 rounds in high, medium, and low confidence environments. To avoid replicating these results, only the highest performing round (the Berger 230 OTM) will be considered here in comparison to 338 Lapua Mag performance.

As for the 338 Lapua Mag, the 4 rounds in Table 1 will be considered.
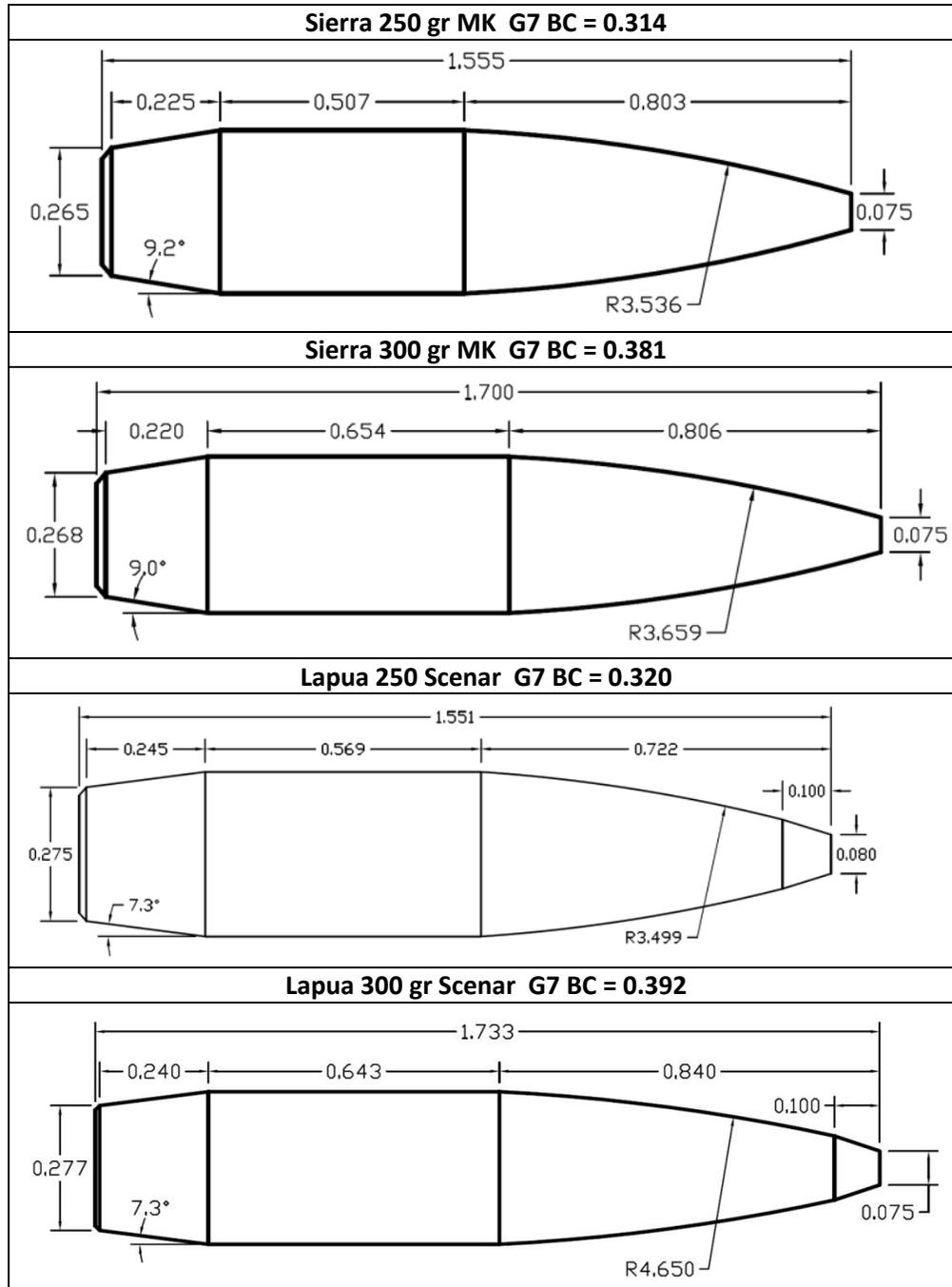
The 230 grain

Bullet	300SMK/ Scenar	250SMK/ Scenar	300 Hybrid	250 Hybrid
G1 BC	0.756	0.605	0.816	0.682
G7 BC	0.387	0.310	0.418	0.349
MV (24" barrel)	2700 fps	2950 fps	2700 fps	2950 fps

Table 1. Various .338 bullets considered[1].

[1] Note the Sierra MatchKing and Lapua Scenar bullets have very similar BC's within a given weight. The BC's used for these bullets are averaged for the SMK and Scenar. The difference between this average and the actual measured BC's for those bullets is less than 2%.

Berger OTM load for the 300 Win Mag has a G7 BC of 0.380, and a MV of 2800 fps (XM-2010; 24" barrel).

Table 2 below shows dimensioned drawings for the 6 .338 caliber bullets being considered in this analysis.

Sierra 250 gr MK G7 BC = 0.314

Sierra 300 gr MK G7 BC = 0.381

Lapua 250 Scenar G7 BC = 0.320

Lapua 300 gr Scenar G7 BC = 0.392

Figure 1. Dimensioned drawings of Sierra and Lapua 250 and 300 grain bullets.

The reason why the 300 grain SMK and the 300 grain Scenar are grouped together is because they're BC's are so similar as to cause no significant difference in performance. The 300 grain SMK has a G7 BC of 0.381, while the 300 grain Scenar has a G7 BC of 0.392, for an average of 0.387. Both bullets are within 2% of the average. The same reasoning applies to averaging BC's for the 250 grain SMK and 250 grain Scenar, which have G7

BC's of 0.314 and 0.320 respectively. In the case of the 250 grain bullets, both are within 1% of the average **[Ref 3]**. For the purposes of this WEZ analysis, 250 grain SMK and Scenar bullets will be modeled together, and the 300 grain SMK and Scenars will be modeled together as well.

However the Berger 250 and 300 grain Hybrids have BC's that are different enough (meaning about 10% higher for each weight) from the SMK's and Scenars that they will be modeled separately.
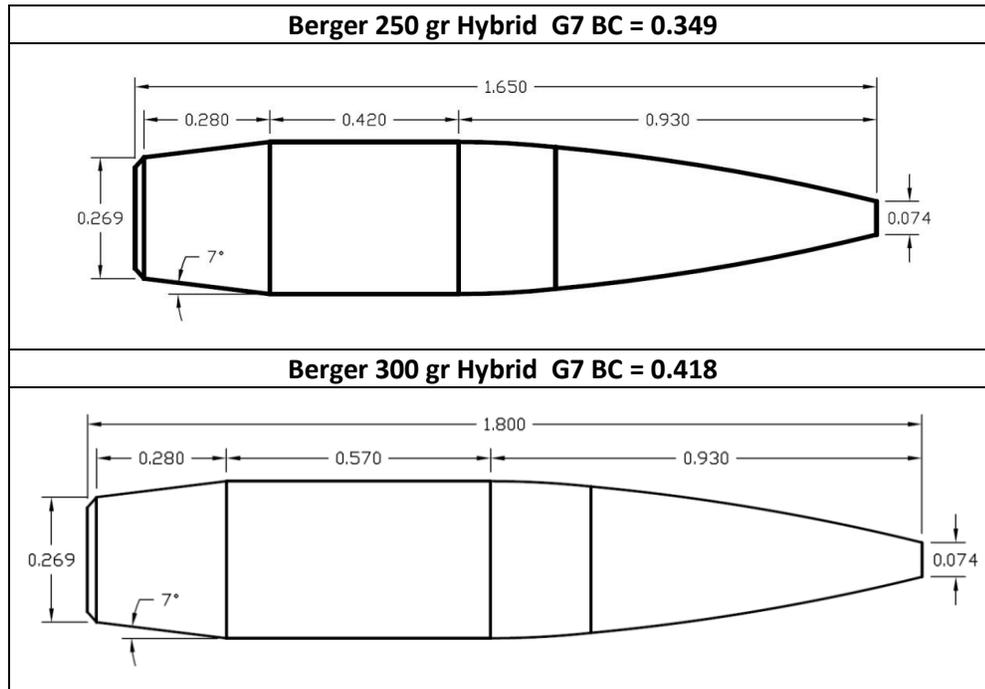
Berger 250 gr Hybrid G7 BC = 0.349

Berger 300 gr Hybrid G7 BC = 0.418

Figure 2. Dimensioned drawings of Berger 250 and 300 grain Hybrids.

The photos shown in Table 1, as well as the dimensioned drawings show clearly the dimensional differences of the Berger Hybrids which allow for the lower drag and higher BC. Namely the noses and boat tails are longer, which reduces drag. Note that these Berger designs are not full blown *VLD's* which is a design characterized by seating depth sensitivities. The hybrid ogive is far more length tolerant which makes the Hybrid bullet a viable option for loading ammunition for many rifles with various chamber dimensions.

Uncertainty Environments

In order to produce meaningful hit percentages, the elements of uncertainty in the shooting environment need to be modeled responsibly. In order to allow for tie-back to **[Ref 1]**, we'll use the same uncertainty environments for high and medium confidence. However, due to the nature of the weapons being considered, this report will omit the low confidence environment.

	Confidence	
	High	**Medium**
Cross Wind Estimation	+/- 1 mph	+/- 2.5 mph
Range Estimation	+/- 1 meter	+/- 10 meters
Rifle/Ammo Precision	0.5 MOA	1.0 MOA
Velocity Consistency	10 fps SD	15 fps SD

Table 2. The uncertainty levels chosen to represent high and medium confidence are primarily important for allowing *apples-to-apples* comparisons among weapon systems and with other WEZ reports.

It is unlikely that any shooter equipped with either an XM-2010 or a .338 PSR rifle will not be equipped with a rangefinder, or have ammo with 20 fps standard deviation in MV. Also, **[Ref 2]** showed that the performance differences between the various ammo types for 300 Win Mag was minimal for the low uncertainty environment. This analysis will proceed with the high and medium confidence environmental variables shown in Table 2.

Modeling

The standard IPSC target, shown with dimensions in Figure 3 will be used to calculate hit percentage for this analysis. This is the same target model used in **[Ref 2]** for the 300 Win Mag performance assessment. With the use of similar uncertainty environments and the same target, the hit percentages calculated from ABWEZDOC102 **[Ref 2]** and ABWEZDOC103 are directly comparable.

Likewise the benchmark for kinetic energy (KE) is set at 1000 ft-lb, and the transonic (TS) velocity is Mach 1.2, or 1339 in standard conditions. Note that transonic stability is not implied by the calculation of hit percentage past TS range. The projectile may or may not remain stable in various DA environments, and so the true

Figure 3. IPSC target.

hit percentage beyond the TS range can be considered equal to or less than that shown in the following calculations. Typically the shorter bullets (250 grain in this case) maintain transonic stability better than the longer 300 grain options, but again, no assumptions are made in this analysis.
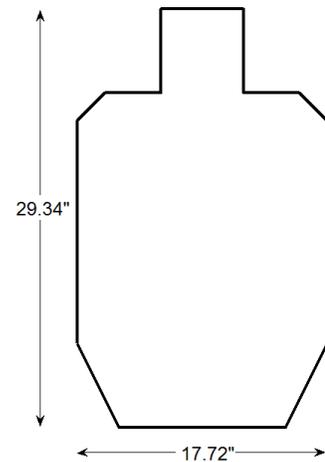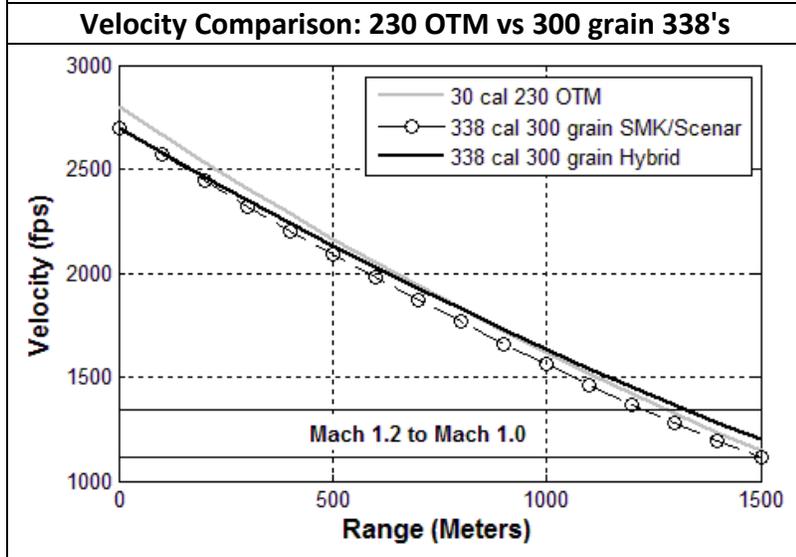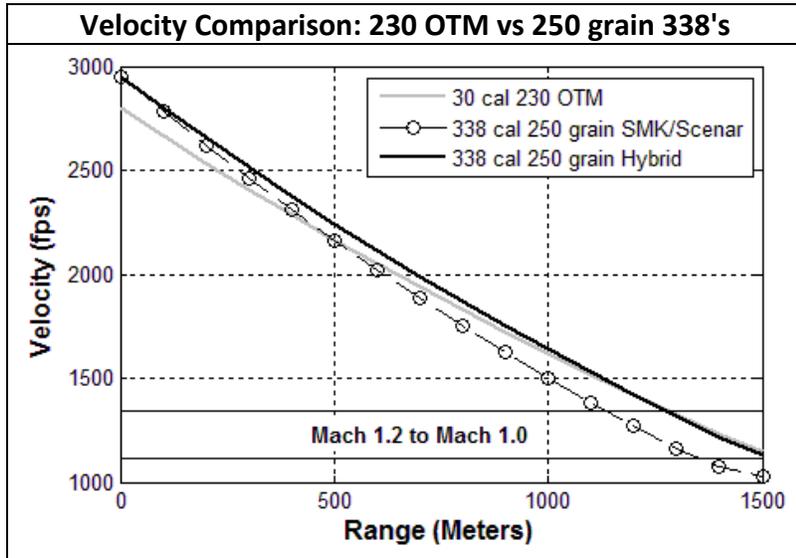
Results and Analysis - Velocity Retention

Figure 4 shows several velocity comparisons. The 30 cal 230 grain OTM is shown in gray compared to the 250 grain .338 bullets on the top, and compared to the 300 grain .338 bullets on the bottom.

The interesting thing about this comparison with the 230 OTM in 300 Win Mag is the muzzle velocity of that round it almost 1/2 way between the 250 and 300 grain bullets from the .338. The 250 grain .338 bullets start out 150 fps faster than the 230 OTM. The 250 grain SMK/Scenar looses it's advantage in velocity at 490 meters. The 250 grain Hybrid maintains it's speed advantage all the way to 1200 meters. Beyond 1200 meters, the 230 OTM retains more velocity than either 250 grain .338 bullet, although the difference only amounts to less than 20 fps at 1500 meters compared to the 250 grain Hybrid. Beyond 600-700 meters, the 30 cal 230 OTM and the .338 cal 250 Hybrid are very close in velocity.

The comparison with the 300 grain bullet is shown in the bottom plot. In the case of the 300 grain bullets, the muzzle velocity is slower in comparison to the 230 OTM, and the heavier bullets gradually gain ground on the faster 30 cal 230 OTM. In this comparison, the .338 cal 300 grain Hybrid is slower than the 230 OTM out to 800 meters, at which point it overtakes the 30 cal 230 OTM in velocity. *However, the 300 grain SMK/Scenar remains slower than the 30 cal 230 OTM to beyond 1500 meters.* In other words, if the 300 Win Mag is loaded with its highest performing ammunition option, it will retain more velocity from the muzzle to beyond 1500 meters than the .338 Lapua Mag loaded with 250 or 300 grain SMK or Scenar bullets. The only option for the .338 Lapua Magnum to retain more velocity at 1500 meters than the 230 OTM is to choose the 338 caliber 300 grain Hybrid bullet. It's important to keep in mind that the performance represented by the 30 caliber 230 grain OTM is the optimal performance possible for the 300 Win Mag, and is far in excess of the 190 or 220 grain SMK loads which are currently fielded as A191 and MK248 Mod1.

As Figure 4 illustrates, the velocity comparison of the various bullets and calibers is very interesting. .338 caliber 250 grain bullets are faster than the 30 cal 230 OTM at short-medium

Velocity Comparison: 230 OTM vs 250 grain 338's

Velocity Comparison: 230 OTM vs 300 grain 338's

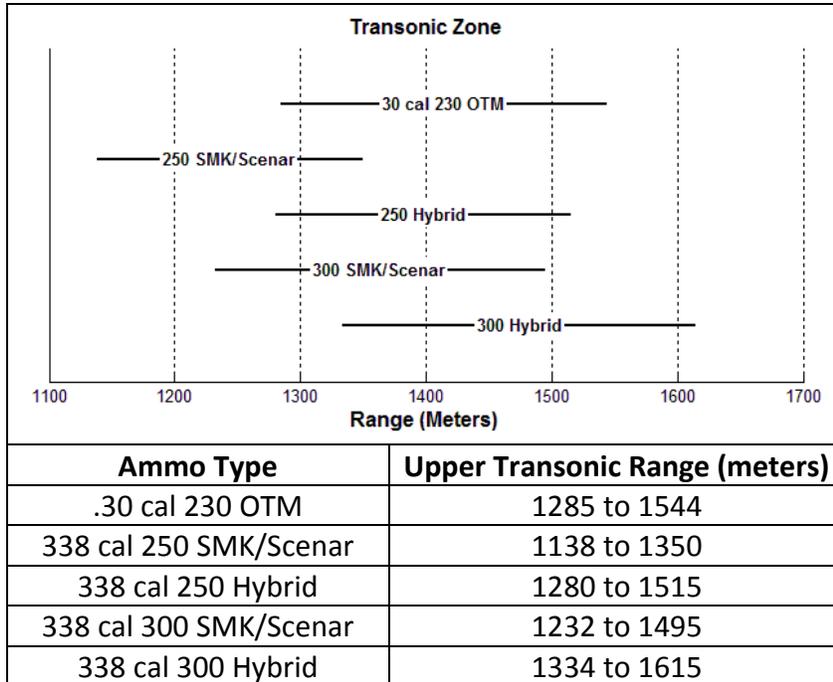|	30 Cal	338 Cal			
	230 OTM	SMK/Scenar		Hybrid	
		250	300	250	300
Muzzle	2800	2950	2700	2950	2700
500m	2165	2162	2089	2244	2132
1000m	1813	1499	1561	1640	1633
1500m	1148	1030	1112	1128	1200

Figure 4. The retained velocity comparisons between the .30 cal 230 OTM and the various bullet options for .338 caliber are very interesting. The 250 is faster at short to medium range, but the 300 grain Hybrid retains more velocity at long range. The 300 grain SMK/Scenar remains slower than the 230 OTM at all ranges.

range, whereas the 300 grain Hybrid only catches up in velocity beyond 800 meters, and the 300 grain SMK/Scenar *never* exceeds the .30 caliber 230 OTM at any range. This result shouldn't be surprising as the .30 caliber 230 OTM has essentially the same G7 BC as the .338 caliber 300 grain SMK/Scenar (0.380 vs 0.387) and has a 100 fps advantage in MV. From a velocity retention point of view, the 300 Winchester Magnum compares very well with the .338 Lapua Magnum, *but only if the optimal bullets are used*. The 190 and 220 grain SMK bullets do not come close to optimizing the performance of the 300 Winchester Magnum, and when using those bullets, the .338 Lapua Magnum is superior across the board.

Ammo Type	Upper Transonic Range (meters)
.30 cal 230 OTM	1285 to 1544
338 cal 250 SMK/Scenar	1138 to 1350
338 cal 250 Hybrid	1280 to 1515
338 cal 300 SMK/Scenar	1232 to 1495
338 cal 300 Hybrid	1334 to 1615

Figure 5. Graphic comparison of the upper transonic zone for the 5 ammo types. Upper transonic zone is from Mach 1.2 to Mach 1.0.

Figure 5 shows graphically where the upper transonic ranges fall for the 5 ammo types being compared. For the purposes of this discussion, the *upper transonic zone* is from Mach 1.2 to Mach 1.0 (1339 fps down to 1116 fps). This is the zone in which the bullet might begin to exhibit transonic instability. In other words, if the bullet is going to have transonic stability problems, those problems will onset somewhere in the upper transonic zone. Note that not all bullets will suffer from transonic instability, and atmospherics will play a major role in this.

Results and Analysis - Kinetic Energy

Debatable as its importance might be, Kinetic Energy (KE) is an important consideration for some shooters, specifically those engaging certain types of targets. A minimum acceptable level of KE is arguable, but for those who wish to consider it, a KE of 1000 Ft-lb is identified as being a benchmark value and the various rounds are compared as to the range they carry this 1000 Ft-lb to.

1000 Ft-lb of Kinetic Energy	
.30 cal 230 OTM	1220 meters
338 cal 250 SMK/Scenar	1134 meters
338 cal 250 Hybrid	1277 meters
338 cal 300 SMK/Scenar	1360 meters
338 cal 300 Hybrid	1470 meters

Table 3. Range to which each round carries 1000 Ft-lb of kinetic energy.

Table 3 shows the ranges at which each round's KE is depleted to 1000 Ft-lb in standard sea level conditions. Note that KE depends on remaining velocity which depends on altitude. In other words, at higher altitudes, these ranges can be much greater than those shown in Table 3 for sea level conditions.

Results and Analysis - Hit Percentage

All of the conclusions discussed in this section are supported by the graphic and tabular data shown in the Appendix. This hit percentage analysis assumes correct fire control solutions. In other words, average elevation and windage corrections are assumed to be perfect.

In reality, this situation typically comes about only after firing a first shot, correcting, and re-engaging the target with a corrected fire solution. This is the only fair way to compare the weapon system itself without confusing the issue with uncertainties related to calculating a fire solution. Both the medium and high confidence scenarios are modeled, and samples of the virtual targets are shown in both sections to illustrate the shot scatter which is used to calculate hit percentage.

High Confidence (Low Uncertainty) Environment

In a high confidence environment[2] the hit percentage is maximized at each range due to the uncertainties being at a minimum.

The full hit percentage tables are shown in the appendix of this report. They show that in a high confidence environment that there is little difference in hit percentage for the various rounds being compared. Hit percentage remains at 100% out to 900 meters for all rounds except the 250 grain SMK/Scenar, which retains 100% out to 800 meters. At 1000 meters, the hit percentage drops off at various rates for each round. By 1200 meters, the relative differences in hit percentage are maximized for the various ammo types. However the differences remain relatively small.

Figures 6 and 7 show graphically the hit pattern on the IPSC target at 1300 meters. There is some visual difference in these patterns, but not a dramatic difference.
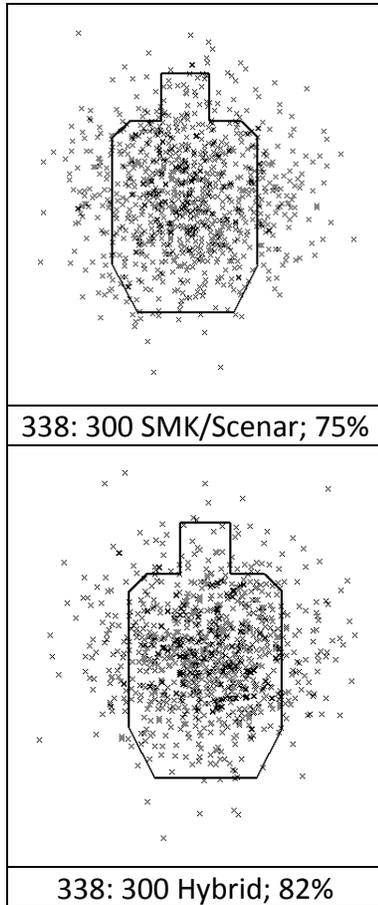

300 Win Mag: 230 OTM; 77%

338: 250 SMK/Scenar; 71%

338: 250 Hybrid; 79%
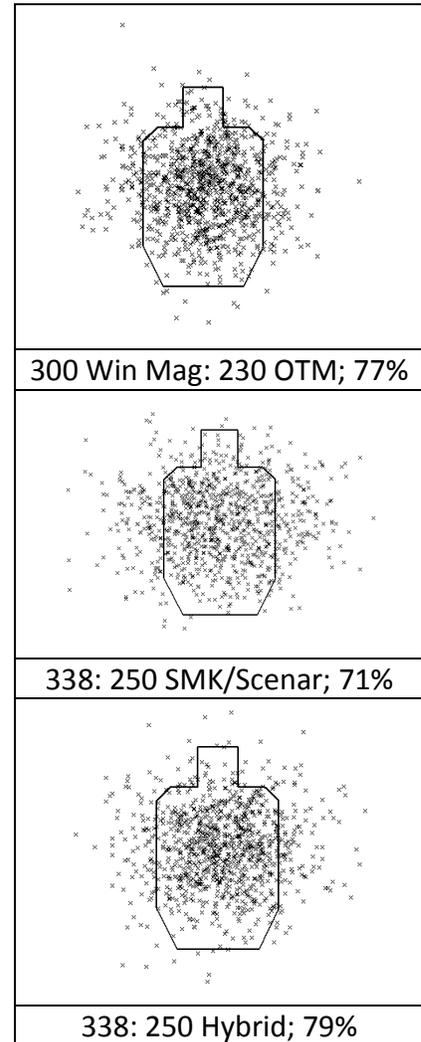
Figure 6. Hit percentage at 1300 meters.

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[2] Table 2 shows the exact numeric uncertainties used to model a *high confidence* environment.

The 300 Win Mag with 230 OTM Hybrid bullets score 77% hit percentage at 1300 meters, which is 6% better than the 338 with 250 grain SMK/Scenar, 2% better than the 300 grain SMK/Scenar, and 2% worse than as the 250 grain Hybrid. Note that small differences like 2% are relatively meaningless, and represent practical equality. The only option for besting the hit percentage of the 300 Win Mag with the 230 OTM ammo type with 338, is the 300 grain Hybrid, which only achieves 5% better hit probability at 1300 meters. Note these relative hit percentages are roughly the same from 1200 to 1500 meters.

It's also important to remember that the performance being represented for the 300 Win Mag is the absolute optimal performance possible, with the 230 Berger OTM Hybrid bullet. If one were to consider 338 options in comparison to A191 or MK248 Mod1 ammo types for the 300 Win Mag, then the comparison quite favors the 338. For example, at 1300 meters, the 300 Win Mag can hold its own with the 338's when loaded with the 230 OTM, however, the A191 and MK248 ammo types have 21% and 11% lower hit percentages, respectively.

Another interesting metric to consider is the 90% hit range. This is the range at which the hit percentage is 90% under the given conditions. Table 4 shows the 90% hit ranges for the ammo types being considered.

All of the ammo types are within 83 meters of the same 90% hit range. 1117 meters for the 250 SMK/Scenar is the shortest. The 338 caliber 300 grain hybrid is the stand out with a 1200 meter 90% hit range. This exceeds the 300 grain SMK/Scenar by 58 meters.

338: 300 SMK/Scenar; 75%

338: 300 Hybrid; 82%

Figure 7. Hit percentage at 1300 meters for 338 caliber 300 grain bullets.

90% Hit Percentage High Confidence	
230 OTM	1161 meters
250 SMK/Scenar	1117 meters
250 Hybrid	1173 meters
300 SMK/Scenar	1142 meters
300 Hybrid	1200 meters

Table 4. Ranges to which each round retains 90% hit percentage.

Once again remember that the 300 Win Mag when used with A191 or MK248 Mod1 ammo types only has a 90% hit percentage out to 1033 meters and 1090 meters, respectively.

Medium Confidence (Medium Uncertainty) Environment

The nominal uncertainties which characterize medium uncertainty WEZ are shown in Table 2. The WEZ is somewhat limited by uncertainties considered average for trained shooters and

average equipment. These uncertainties are somewhat limiting compared to the high confidence (low uncertainty) environment.

Full tables are shown in the appendix. Some interesting observations will be pointed out here. In the previous high confidence environment, we noted the difference between ammunition options was rather minor, only amounting to ~5% or so. We also recall from **[Ref 2]** that the greater uncertainty there is in the environment, the less clear the advantage is for better performing rounds. Since we're already considering ammo types that are not dramatically different from each other, the variables associated with the medium confidence environment overshadow the small ballistic advantage of the superior rounds. The

plots of hit percentage are close and even cross over at some points. The reader is reminded of the statistical nature of this modeling, and that hit percentage calculations are repeatable within only a couple %. The biggest conclusion to be drawn from these results is that there is effectively little to no difference in the hit percentage of these rounds in a medium confidence environment.

90% Hit Percentage Medium Confidence	
230 OTM	789 meters
250 SMK/Scenar	740 meters
250 Hybrid	770 meters
300 SMK/Scenar	759 meters
300 Hybrid	804 meters

Table 5. Ranges to which each round retains 90% hit percentage.

The 90% hit percentage ranges shown in Table 5 illustrates just how little difference there is between these rounds in a medium confidence environment. The min to max is only separated by 64 meters (from 740 meters to 804 meters). Due to the lack of substantial difference among these ammo types in a medium confidence environment, the IPSC target scatter plots are not included here (they all look the same).

Other Considerations

The focus of a WEZ report is a comparison of hit percentages. However there is far more to consider when deciding between weapon platforms and/or ammunition types. The following topics touch on some other considerations related to effective weapon employment.

Barrel Considerations

Barrel life is one consideration worth mentioning in the context of deciding which rifle is *best.* In a comparison between 300 Win Mag and 338 Lapua Magnum, there is not likely to be a significant difference in barrel life, at least not when all other variables like; rate of fire, different ammo types, metallurgy, environment, etc are considered. In general, one might argue that the heavier, slower moving bullets could reduce the rate of barrel wear compared to lighter faster moving bullets and hot expanding gasses.

Another consideration involving barrels is the muzzle velocity that can be achieved, and the effect this has on performance. A rifle barrel that's 2" or 4" longer may be more difficult to maneuver around a battlefield especially with a suppressor attached. However, the extra 200

or 300 fps additional MV could pay huge dividends downrange in terms of hit percentage. A barrel length of 24" was assumed for the 300 Win Mag (XM-2010 configuration). The barrel length of the 338 Lapua Mag PSR has not been fully established yet. To make a fair comparison with the 300 Win Mag, a barrel length of 24" was assumed, which produces the approximate velocities used in this report: 2700 fps for 300 grain bullets and 2950 fps for 250 grain bullets. Lengthening the barrel of either rifle (the M24 had a 26" barrel) would increase ballistic performance and hit percentage. Since the purpose of these WEZ reports is apples-to-apples comparisons, the common barrel length of 24" was modeled.

Terminal Performance

The WEZ assessment is primarily a study of external ballistic performance, and hitting targets. What the bullet does after impacting the target is an issue outside the scope of the main WEZ analysis, but requires consideration in applications where terminal performance is specified.

All 5 bullets under consideration are of similar construction: open tip, match bullets with relatively thick copper jackets and lead cores. This type of construction produces the most precise bullets available, while achieving desired terminal performance which is characterized by limited penetration at short range (high velocity) and high weight retention and penetration at long range (low velocity) impacts. All 5 of the bullets under consideration share the same materials and construction, and exhibit the same desirable terminal performance attributes.

Summary

While some WEZ reports are important because they show dramatic differences in performance between weapon systems, an equally important result is to know when there is little difference in performance. The main conclusion of this analysis is that the 300 grain bullets are only marginally better than the 250 grain options in the 338 Lapua Magnum, but this difference can only really be resolved by elite shooters in the highest confidence environments. The 300 grain Berger Hybrid is the highest BC and highest performing bullet available for the 338 Lapua Magnum, but it only outperforms the 300 grain SMK/Scenar by 4% to 10% hit percentage beyond 1200 meters (up to 1200 meters there's even less difference). The 250 grain options don't show remarkably lower hit percentages than the 300's.

The 338 Lapua Magnum does outperform the 300 Win

Figure 8. From Left to Right: 300 Winchester Magnum with 190 grain SMK (A191), 300 Winchester Magnum with 230 grain Berger OTM Hybrid, 338 Lapua Magnum with 300 grain Berger Hybrid.

Mag with A191 and MK248 Mod1 **[Ref 1]** by a substantial margin, regardless of what 338 ammo is being used. However, if loaded with the 230 grain Berger OTM Hybrid option, the 300 Win Mag is very comparable in performance, achieving similar hit percentages as the 338 Lapua Mag with all bullet options. In fact, the 300 Win Mag loaded with the 230 OTM bullet outperforms both 250 and 300 grain Sierra MatchKing bullets in .338. But the 338 Lapua Mag loaded with either 250 or 300 grain Berger Hybrids will outperform the 300 Win Mag loaded with 230 OTM's.

Appendix

WEZ plot and hit percentage tables for a high confidence environment.

High Confidence WEZ

.30 Cal 230 OTM (300 Win Mag) vs 250 and 300 grain .338 cal Bullet Options

	30 cal	.338 Caliber				
		250 grain		300 grain		
Range Meters	230 OTM	SMK/ Scenar	Hybrid	SMK/ Scenar	Hybrid	Criteria
100	100%	100%	100%	100%	100%	This WEZ was run for a high
200	100%	100%	100%	100%	100%	confidence set of environmental
300	100%	100%	100%	100%	100%	variables including the following:
400	100%	100%	100%	100%	100%	Wind determination: +/- 1.0 mph
500	100%	100%	100%	100%	100%	Range determination: +/- 1.0
600	100%	100%	100%	100%	100%	meters
700	100%	100%	100%	100%	100%	Rifle/Ammo precision: 0.5 MOA
800	100%	100%	100%	100%	100%	Ammunition consistency: 10 fps
900	100%	99%	100%	100%	100%	SD
1000	98%	96%	98%	99%	99%	
1100	95%	92%	94%	93%	96%	
1200	87%	83%	88%	86%	90%	
1300	77%	71%	79%	75%	82%	
1400	66%	58%	67%	62%	72%	
1500	53%	45%	57%	48%	58%	

A1. Hit percentage comparison in high confidence scenario. Note the hit percentage numbers shown in gray are associated with ranges beyond the transonic (TS) range of the projectile.

WEZ plot and hit percentage tables for a medium confidence environment.

Medium Confidence WEZ

.30 cal 230 OTM (300 Win Mag) vs 250 and 300 grain .338 cal Bullet Options

| Range Meters | 30 cal | .338 Caliber | | | | Criteria |
| | | 250 grain | | 300 grain | | |
	230 OTM	SMK/Scenar	Hybrid	SMK/Scenar	Hybrid	
100	100%	100%	100%	100%	100%	This WEZ was run for a medium
200	100%	100%	100%	100%	100%	confidence set of environmental
300	100%	100%	100%	100%	100%	variables including the following:
400	100%	100%	100%	100%	100%	Wind determination: +/- 2.5 mph
500	100%	100%	100%	100%	100%	Range determination: +/- 10.0
600	100%	99%	99%	100%	100%	meters
700	97%	94%	96%	96%	98%	Rifle/Ammo precision: 1.0 MOA
800	89%	84%	88%	86%	90%	Ammunition consistency: 15 fps
900	76%	70%	73%	76%	79%	SD
1000	63%	57%	59%	63%	66%	
1100	51%	43%	47%	51%	52%	
1200	39%	32%	37%	37%	41%	
1300	31%	24%	28%	27%	30%	
1400	23%	18%	21%	19%	24%	
1500	17%	12%	15%	13%	17%	

A2. Hit percentage comparison in medium confidence scenario. Note the hit percentage numbers shown in gray are associated with ranges beyond the transonic (TS) range of the projectile.

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