Addendum 5. ASAP East & West projections.

Projections of the East and West Gulf of Mexico red snapper stocks were carried out for the ASAP model evaluations. Two main groups of projections are presented: a) projections under a constant catch quota (TAC) and different levels of shrimp bycatch fishing mortality reduction, and b) projections under a constant fishing mortality of the directed fisheries and different levels of shrimp bycatch F reduction.

The projections discussed here corresponded to ASAP model assessments which considered catch and effort data starting in 1962 and ending in year 2003, with projections beginning in 2004 through 2032. For the period of 2004 through 2006, a Gulf-wide directed fishery TAC of 9.12 million pounds was equally split between East and West fisheries, while the current fishing mortality rates (averaged over the last three years of the assessment) were applied for the non-directed fisheries (shrimp bycatch and closed season). Beginning in year 2007 the different projection scenarios were then implemented. The mortality rates associated with closed season discarding in the recreational and commercial fishing sectors were held at the current levels throughout the projection period, as it is unclear what future scenarios would result under different management regimes. Projections were done for three levels of assumed steepness in the stock-recruitment relationship for both eastern and western stock assumptions (values of 0.81, 0.90, and 0.95 were applied), and assuming a high natural mortality vector (Age 0 = 0.98, Age 1 = 0.59, Age 2+ = 0.1). It is important to point out that these projections as well as the ASAP assessment treat the East and West GOM red snapper as completely independent stocks, with not relation between them at all what so ever. This is completely different modeling approach as the CATCHEM model program, which also considers East and West GOM red snapper evaluations (Ref).

For the East stock, projections of constant harvest were implemented for TACs of 0, 2, 4, 6, and 8 million pounds, with reductions of shrimp bycatch of 0, 20, 40, 60, 80 and 100% compared to the average of the most recent 3-year (2001-2003) estimated levels. Because the stock evaluations indicated higher overall productivity in the west, for the West stock, projections of constant harvest were implemented for TACs of 0, 2, 4, 6, 8, 10, 12, 14 and 18 MP, with reductions of shrimp bycatch from 0, 20, 40, 60, 80 and 100%. For both stocks, projections of directed fishery mortality rates were also conducted over the range of status quo levels to 0. The results of these projections were then contoured to provide a basis for interpolating projection outcomes over the range of catch, directed effort, and bycatch reduction levels specified.

Results and Discussion

Reinstating the assessment general results, the analysis of East and West independent stocks with ASAP indicated that the West stock is much more larger than the East component, about 6 to 7 times larger, depending on the assumed steepness (See table # Report ###). This is due primarily to the comparatively large shrimp bycatch observed in the West GOM compared to the East. Thus, everything else equal, the ASAP model interprets that the West stock must be much greater in biomass as a stock in order to produce the observed bycatch levels, particularly in the early years (1962-1975). This of course is also reflected in the projections of the East and West stocks. Overall, the East stock is over-exploited, with lower spawning stock compared to MSY levels (SS/SS_{MSY}), and low spawning potential ratios (transitional SPR) at the end of 2003, particularly for the assumed higher steepness (0.95) runs. For the West stock, at 2003 the stock is overexploited, with spawning stock below to MSY levels (SS/SS_{MSY}), and spawning potential ratios between 33% and 9% (depending on assumed steepness). However for the West stock, ASAP results indicated that the directed fishing mortality rates are low and shrimp bycatch is the main mortality component in this stock. Also, estimates of MSY for the west stock are much greater than any catch observed historically.

Projection results are grouped by the assumed steepness (0.81, 0.90, 0.95) and by year 2010 and 2032 (Figures 1 to 6). In general, reduction of shrimp bycatch has a larger effect in the West compared to the East stock. The slopes of the tSPR isopleths in the West are much higher than in the East, particularly at 2032. Assumed steepness has also an impact in the current status and projections of the East and West stocks. The East stock, at the lower steepness (0.81, 0.90) show higher tSPR values in 2010 and 2032 compared to the high steepness (0.95) projections. For the East stock Spawning stock would reach SS_{MSY} levels in 2032 with a 4 MP TAC and no bycatch reduction, or 5 MP TAC and 100% reduction of bycatch, at the 0.95 assumed steepness (Fig 6), however at this levels, still tSPR would be below 20%. Yield isopleths indicated that greater catches will be likely at about 70% of current directed fishing rates and complete reduction of shrimp bycatch (Fig 6). Under the lower steepness assumption (0.90 and 0.81), the East stock could reach SSMSY levels in 2032 with TAC between 4.5 and 5.8 MP and no bycatch reduction. However in these cases, tSPR is higher, above 20%.

For the West stock, projections indicated that it can support greater yields in the order of 20 to 30 MP depending on the assumed steepness. Higher yield would be expected with higher shrimp bycatch reductions. West spawning stock biomass in 2032 would be above SS_{MSY} levels at any steepness, with TACs below 18 MP and no bycatch reduction, and tSPR levels would also be above 30%. Estimates of MSY change with shrimp bycatch reduction. Estimated MSY increases as shrimp bycatch decreases. Estimates of SS_{MSY} and the corresponding fishing mortality benchmarks are also recalculated. During the projections, implementation of TAC and shrimp bycatch reduction takes place in 2007. Therefore, the results in 2010, only three years later, , reflect transitional effects of the stock. For example the 2010 SS/SS_{MSY} isopleths show a different trend than the 2032 SS/SS_{MSY} isopleths. The 2010 plots indicate that higher SS/SS_{MSY} ratios are achieved by decreasing TAC and maintaining current shrimp bycatch levels. While in 2032, plots indicate that higher SS/SS_{MSY} ratios are achieved by decreasing TACs and reducing shrimp bycatch effort. This occurs because SS_{2010} is relatively similar among the different shrimp bycatch reduction projection scenarios, (only three years after the scenario is implemented) while the target value, in this case $SS_{MSY,}$ increases substantially as shrimp bycatch effort decreases. Therefore the ratio SS_{2010}/SS_{MSY} is greater for high bycatch levels simply because the denominator is smaller. When the stock has passed several years, so that the dynamic equilibrium is reached (2032), then the trends of the isopleths reflect the true effects of bycatch reduction and constant catch projections.

Stock assessment and projection results of East and West stocks with the current ASAP program are sensitive to initial conditions and user settings regarding relative weighting factors, as indicated in the manual (Legault and Restrepo 1998).

Steepness 0.81 2010

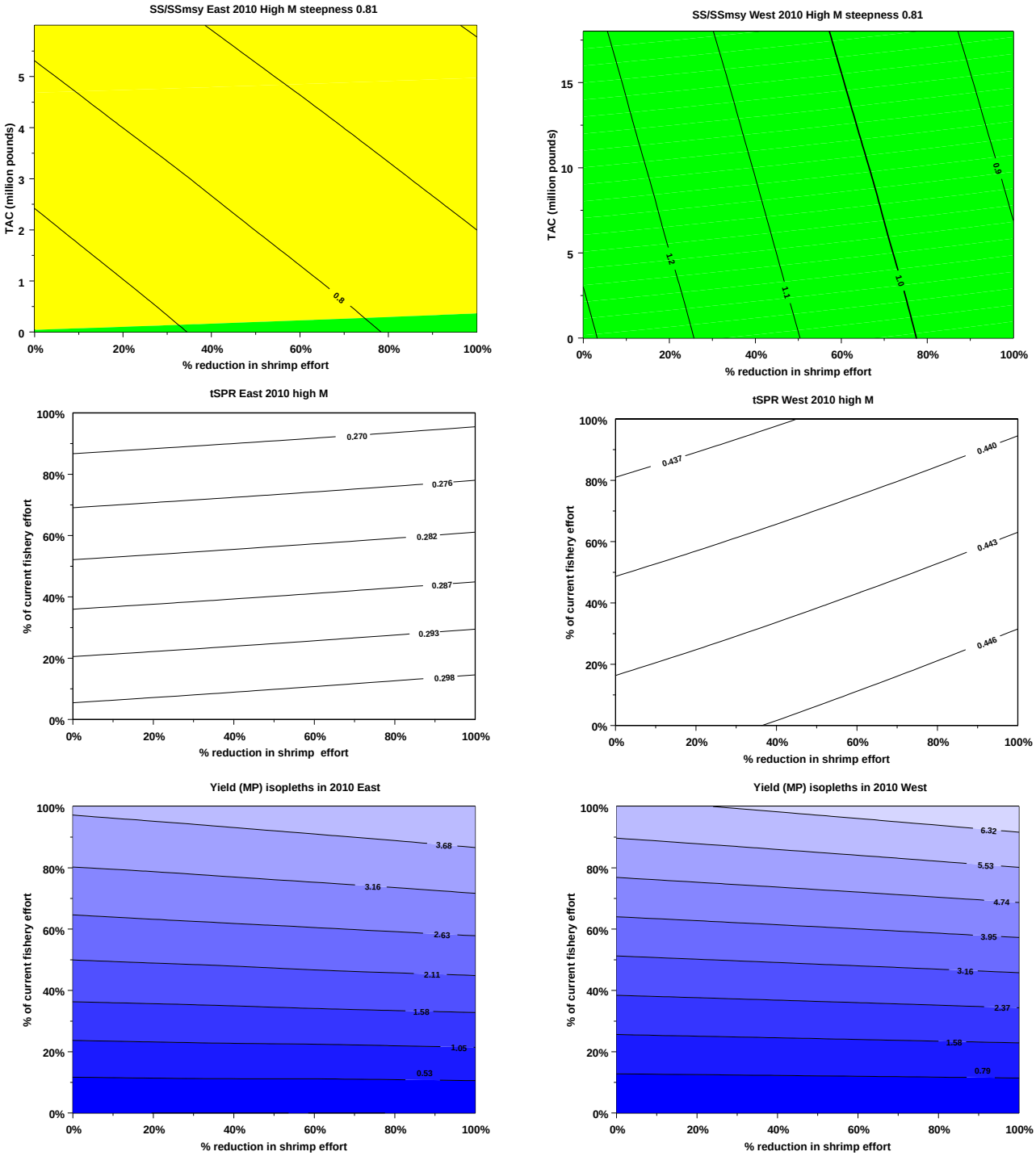

Figure 1. Top row: Isopleths of number of spawners in 2010 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.81.

Steepness 0.81 2032

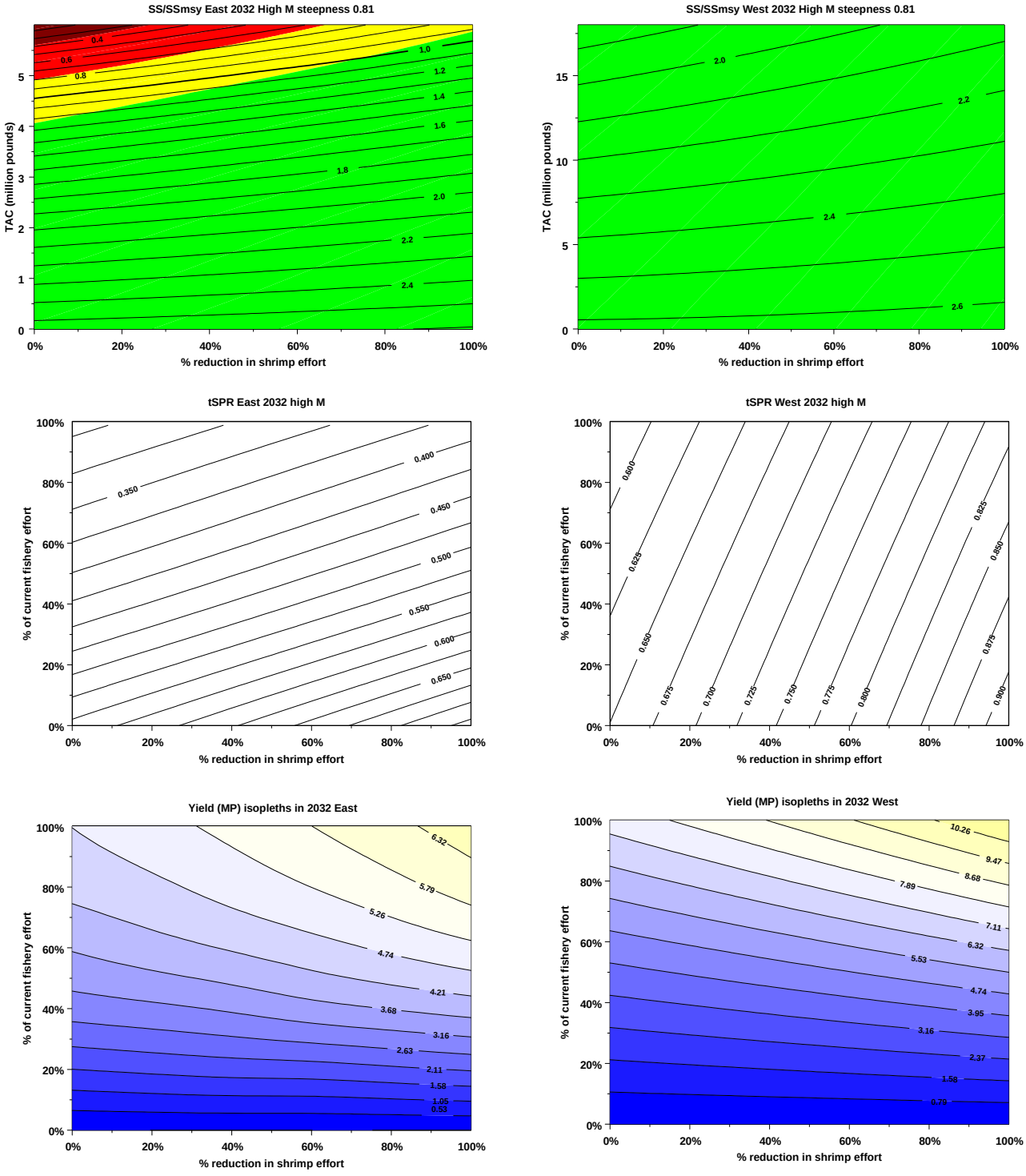

Figure 2. Top row: Isopleths of number of spawners in 2032 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.81.

Steepness 0.90 2010

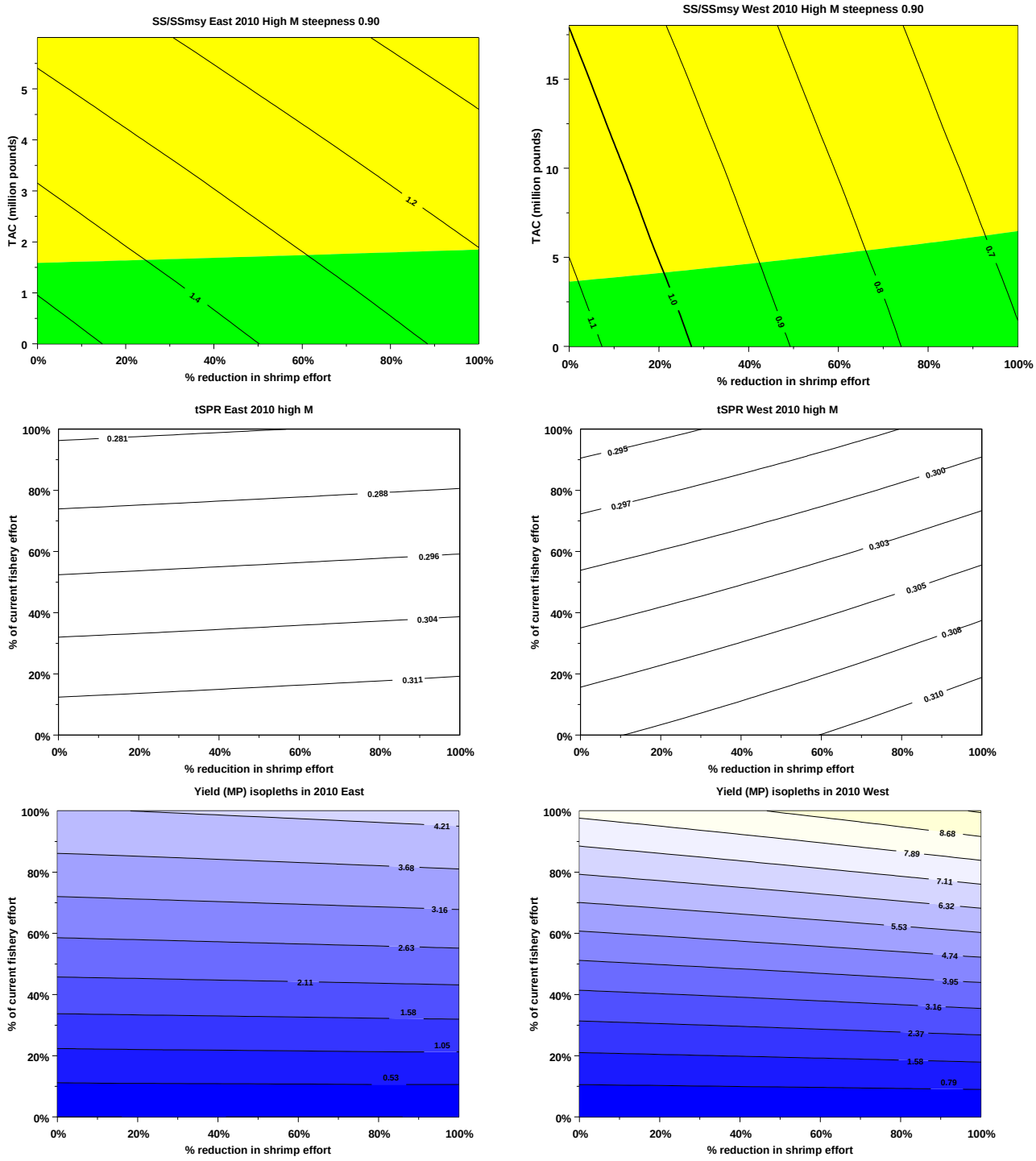

Figure 3. Top row: Isopleths of number of spawners in 2010 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.90.

Steepness 0.90 2032

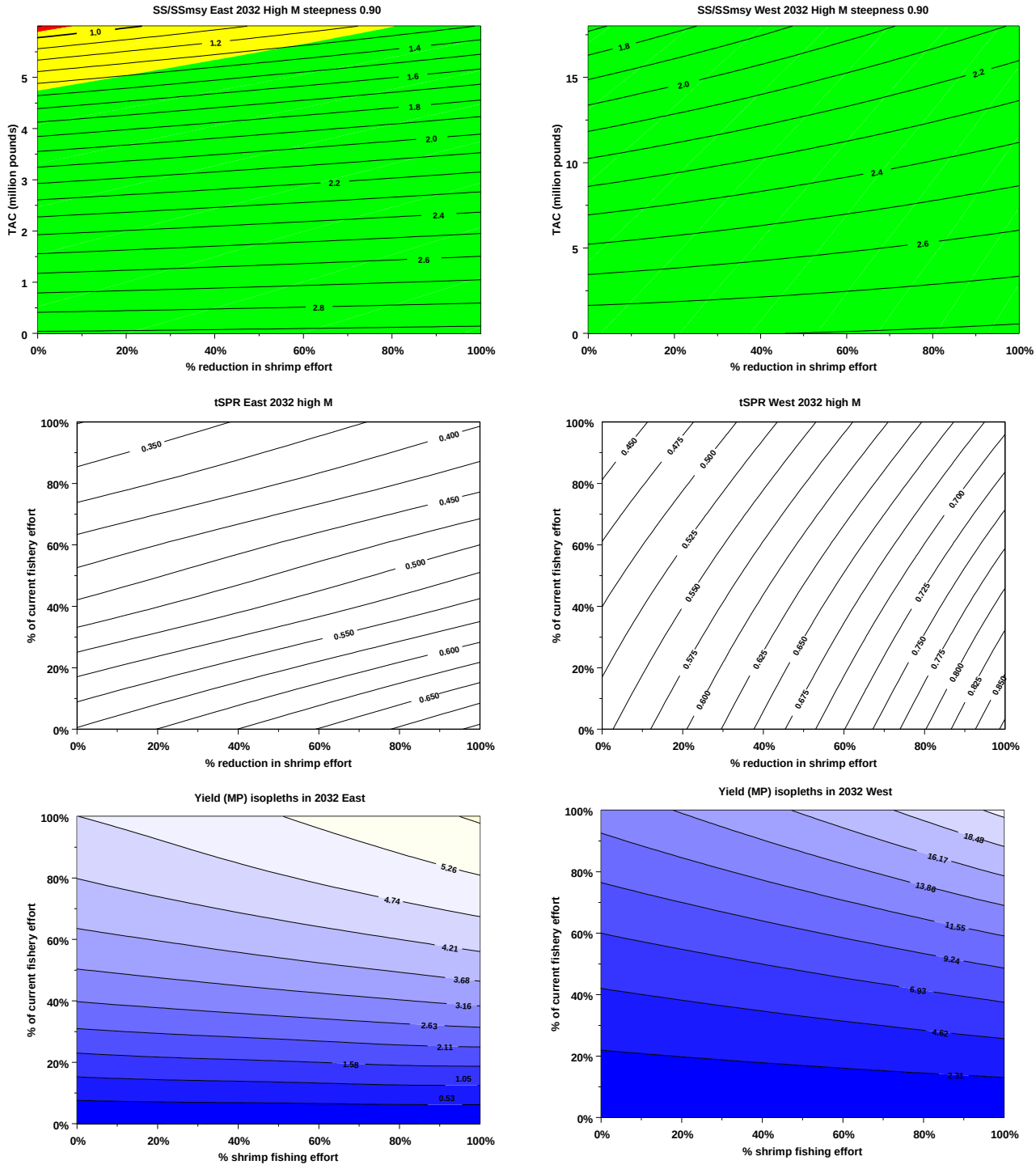

Figure 4. Top row: Isopleths of number of spawners in 2032 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.90.

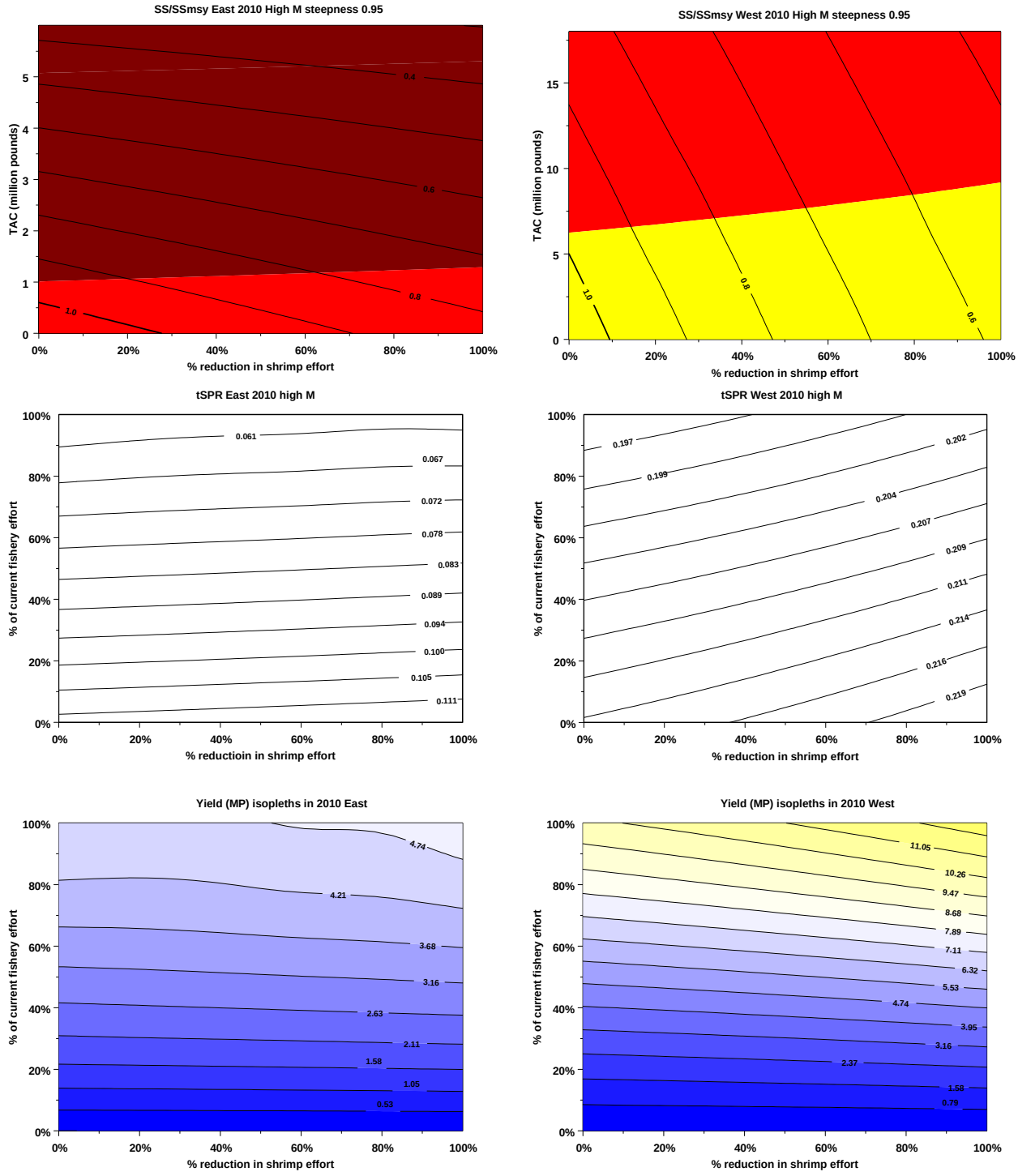

Figure 5. Top row: Isopleths of number of spawners in 2010 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.95.

Steepness 0.95 2032

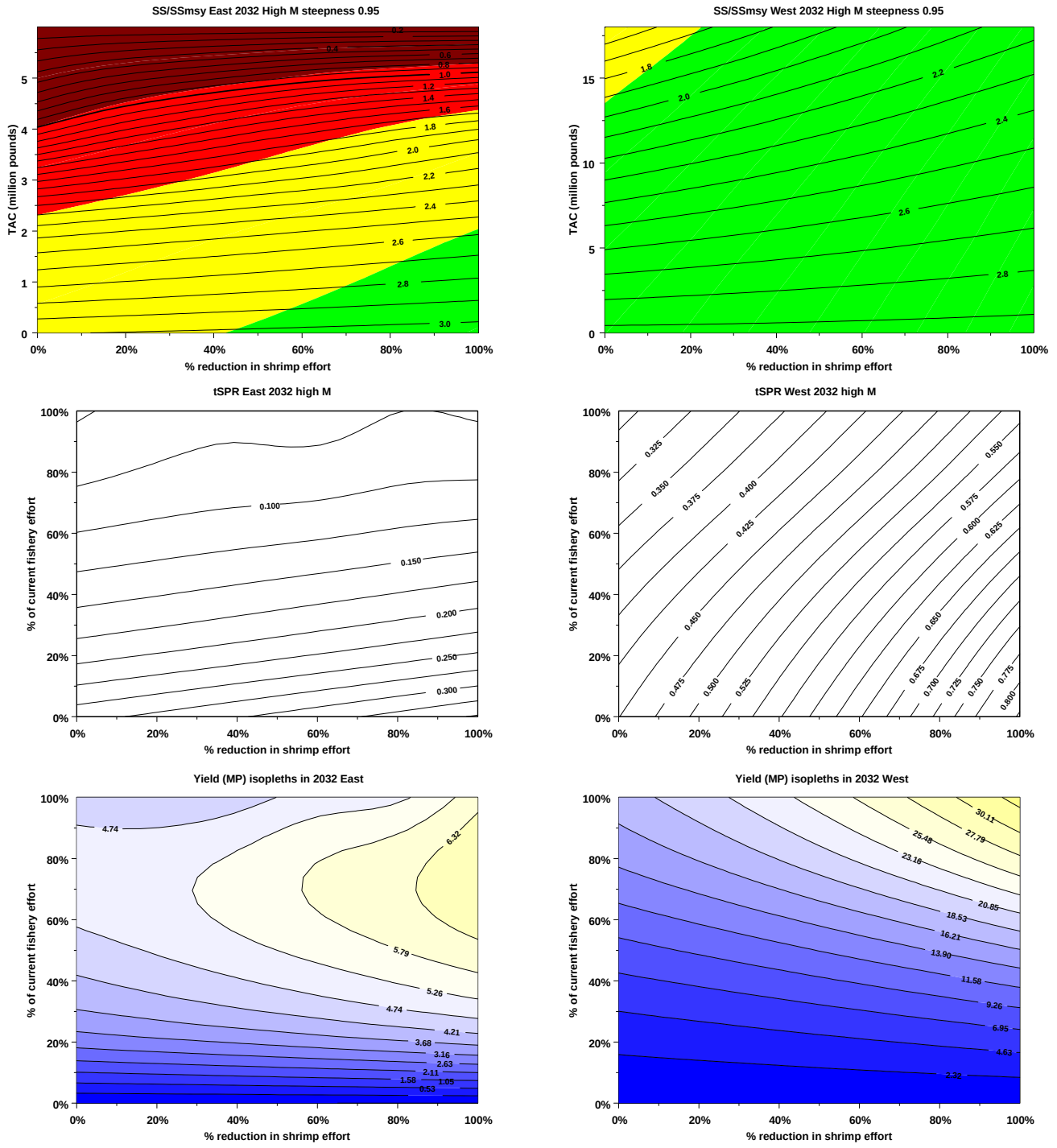

Figure 6. Top row: Isopleths of number of spawners in 2032 relative to MSY levels (SS/SSMSY), where MSY is conditioned on the projected percent reduction in effective offshore shrimp effort (horizontal axis). The vertical axis refers to the projected TAC for the directed fisheries. The shaded color backgrounds represent four regions of corresponding projected transitional SPR isopleths: a) 0% - 10% dark-red, b) 10% - 20% red, c)20%- 30% yellow, and d) >30% green. Middle row: Isopleths of tSPR as a function of percent of current directed fisheries fishing mortality. Bottom row: Isopleths of yield (landings in million pounds) as a function of percent of current F and shrimp bycatch reduction. Results from East (right) and West (left) independent ASAP projections with high mortality vector and steepness of 0.95.