AN EVALUATION OF U.S. BILLFISH LANDINGS IN 1999 RELATIVE TO 1996[1]

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SUMMARY

In 1997 ICCAT recommended that, beginning in 1998, all parties reduce "blue marlin and white marlin landings by at least 25% for each species from 1996 landings, such reduction be accomplished by the end of 1999." This recommendation was based on the SCRS estimation of the biomass of blue marlin (Makaira nigricans) *and white marlin* (Tetrapturus albidus) *being at 24% and 23% of the MSY level, respectively, and on the SCRS recommendation "that reductions in fishing mortality are necessary to avoid further declines in the stocks and to begin rebuilding these stocks." To address this recommendation, U.S. fishery managers increased the minimum size regulations for billfish in 1999 and implemented mandatory tournament registration. An evaluation is presented comparing the U.S. blue marlin and white marlin rod-and-reel catches in 1999 with the 1996 levels, expanding the methodology previously applied to the 1998:1996 preliminary comparison. The current evaluation indicates that for blue marlin the results differ if the analysis is based on numbers or on estimated weight. For blue marlin: (1) There was a 15% decrease from 1996 to 1999 in the absolute number of fish boated; (2) there was a 38% decrease from 1996 to 1999 in fish boated per unit effort; and (3) there was an increase in estimated weight of landings in 1999 by 1% compared to 1996. For white marlin, there was a decrease in 1999 of about 50% in both the absolute number boated and in the estimated weight of landings compared to 1996.*

RÉSUMÉ

L'ICCAT avait recommandé en 1997 qu'à partir de 1998 toutes les parties réduisent "leurs débarquements de makaire bleu et de makaire blanc d'au moins 25% pour chacune de ces espèces par rapport aux débarquements de 1996, cette réduction devant être accomplie avant la fin de 1999". Cette recommandation se fondait sur l'estimation par le SCRS que la biomasse de makaire bleu (Makaira nigricans) *et de makaire blanc* (Tetrapturus albidus) *était respectivement 24% et 23% du niveau de la PME, et sur la recommandation du SCRS "qu'une réduction de la mortalité par pêche est nécessaire pour freiner la baisse des stocks et pour entreprendre leur rétablissement". Pour traiter cette recommandation, les gestionnaires américains des pêches ont haussé la réglementation de taille minimale des istiophoridés en 1999 et ont mis en place une inscription obligatoire des championnats. Une évaluation est présentée, qui compare les prises américaines de makaire bleu et de makaire blanc à la canne/moulinet en 1999 avec celles de 1996, en prolongeant la méthode appliquée antérieurement à la comparaison préliminaire 1998:1996. L'évaluation actuelle indique que, pour le makaire bleu, les résultats diffèrent si l'analyse se fonde sur le nombre ou sur le poids estimé. Pour le makaire bleu: (1) le nombre absolu de poissons hissés à bord a décru de 15% entre 1996 et 1999; (2) le poisson hissé à bord par unité d'effort a décru de 38% entre 1996 et 1999; et (3) le poids estimé des débarquements s'est accru en 1999 de 1% par rapport à 1996. Pour le makaire blanc, le nombre absolu de poissons hissés à bord, comme le poids estimé des débarquements, ont décru d'environ 50% par rapport à 1996.*

RESUMEN

En 1997 ICCAT recomendó que a principios de 1998, todas las Partes redujeran los desembarques de "aguja azul y aguja blanca en al menos un 25% para cada especie, con relación a los desembarques de 1996, y que tal reducción debía alcanzarse al final de 1999". Esta recomendación

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se basaba en la estimación del SCRS de la biomasa de la aguja azul (Makaira nigricans) *y la aguja blanca* (Tetrapturus albidus) *en el 24% y 23% respectivamente del nivel de RMS, y en la recomendación del SCRS "de que son necesarias reducciones en la mortalidad por pesca para evitar un mayor descenso en los stocks y comenzar su recuperación". Para cumplir con esta recomendación, en 1999 los gestores de la pesquería de Estados Unidos aumentaron las regulaciones de talla mínima para los marlines e implementaron un registro obligatorio de torneos. Se presenta una evaluación comparando las capturas de caña y carrete de aguja blanca y aguja azul de Estados Unidos en 1999 con los niveles de 1996, ampliando la metodología previamente aplicada a la comparación preliminar entre 1998:1996. La actual evaluación indica que para la aguja azul, los resultados difieren si el análisis se basa en números o en peso estimado. Para la aguja azul: (1) desde 1996 a 1999 hubo un descenso del 15% en el número absoluto de peces embarcados; (2) desde 1996 a 1999 hubo un descenso del 38% en los peces embarcados por unidad de esfuerzo; y (3) en comparación con 1996, en 1999 hubo un aumento del 1% en el peso estimado de los desembarques. Para la aguja blanca, en comparación con 1996, en 1999 hubo un descenso de cerca del 50% tanto en el número absoluto de peces embarcados como en el peso estimado de los desembarques.*

KEYWORDS

Sport fishing, Fishing effort, Fishery regulations, Fish catch statistics, Monitoring systems

INTRODUCTION

Biomass projections for blue marlin and white marlin stocks in the Atlantic Ocean were reviewed at the 1997 SCRS meeting (Jones 1998) and indicated "that reductions in fishing mortality are necessary to avoid further declines in the stocks and to begin rebuilding these stocks" (ICCAT 1998). Further, it was noted that "the current stock assessment is derived in part from problematic data as indicated in the 1997 SCRS Report," when the SCRS estimated current Atlantic blue marlin and white marlin biomass levels to both be less than 25% of the MSY level. Based on these findings, in 1997 ICCAT made five recommendations that included: (1) Reducing blue marlin and white marlin landings by at least 25% for each species from 1996 landings, starting in 1998, with the reduction to be accomplished by the end of 1999; (2) promotion of the voluntary release of live blue marlin and white marlin; and (3) advising ICCAT annually of measures in place, or to be taken, that reduce landings of marlins or fishing effort in the commercial and recreational fisheries that interact with blue marlin and white marlin.

The National Marine Fisheries Service (NMFS) responded to the 1997 ICCAT recommendations by implementing rulings in 1998 that increased the allowable minimum size for a landed blue marlin caught by sport fisheries from 86" to 96" lower-jaw-fork-length (LJFL) (i.e., 218 to 244 cm LJFL) and for white marlin from 62" to 66" LJFL (i.e., 157 to 168 cm LJFL). Those minimum sizes were based on the 1994-1996 size distribution of U.S. rod and reel (sport) landings. Beginning in September 1998, an increase in the minimum size for blue marlin to 99" (251 cm) was implemented. However, it is important to note that due to rulemaking requirements implementation of the 99" and 66" minimum size regulations was not in effect for the entire 1999 fishing year.

The U.S. Atlantic pelagic longline fishery bycatch of billfish continues as a release-fishery and thus the minimum size changes (U.S. Federal Register 1988; Anonymous 1999) had no direct effect on that gear-type. Recommendation (1) above refers to "landings" and not discarded bycatch. Therefore, the effect of the 1999 management measures on marlin landings is reflected only in the U.S. rod and reel fishery.

This paper evaluates the 1999 U.S. blue marlin and white marlin landings, relative to 1996, by both numbers of marlin boated with associated boated rates, and by weight (t) as reported as Task I data from the rod and reel (recreational) sector. The data are combined for all areas (ICCAT Areas 91, 92 and 93 –

Gulf of Mexico, U.S. Atlantic [including the Bahamas], and the U.S. Virgin Islands/Puerto Rico). This represents an update of the preliminary evaluation of U.S. billfish landings in 1998 relative to 1996 (Farber and Venizelos, 1999) that examined numbers of marlin boated and boated rates. This fishery is monitored through the NMFS Recreational Billfish Survey (RBS) which began in 1971 in the Gulf of Mexico, and expanded to the U.S. East Coast and Caribbean (i.e., U.S. Virgin Islands and Puerto Rico) in 1972. The NMFS RBS data were analyzed in order to assess progress towards reducing blue marlin and white marlin landings in 1999 relative to 1996 as a result of these new increased minimum size regulations.

An additional consideration is that the Task I landings data from the U.S. rod and reel fishery for billfish species have historically been derived as "minimum estimates." These estimates are based on tournament landings recorded by the RBS and supplemented by additional documented landings. Beginning in the late-1980s the Large Pelagics Survey (LPS) generated estimated billfish landings (by species) off the U.S. coast, north of North Carolina by the U.S. sport fishery. When estimates were available from this statistical survey they were used for that sub-region within ICCAT Area 92 in place of the "minimum estimates" generated from the RBS (when such estimates were greater than the reported RBS landings.) In general, there is considerable uncertainty in estimates from statistical surveys due to the rare-event nature of billfish catches in the recreational fishery sector as a whole (Goodyear *et al.* 1999, Appendix 1). Additionally, in some years the LPS would encounter zero blue marlin or white marlin (or sailfish), leading to an estimated landing of zero. In those years, the RBS minimum estimate was used in conjunction with the U.S. southern subregion of ICCAT Area 92 (i.e., North Carolina through the Florida Keys plus the Bahamas). Due to the high variability of landings estimates from the LPS, changes in landings on the order of 25% are unlikely to be statistically detectable. For this reason, this paper focuses entirely on evaluation of RBS data.

DATA AND METHODS

Conservative estimates of landings of blue marlin, white marlin, and sailfish have historically been generated by data from the U.S. Recreational Billfish Survey (RBS), and augmented in the northern states within Area 92 (NWA) by the Large Pelagics Survey (LPS), as noted in the Introduction above. The RBS data are almost exclusively derived from organized billfish recreational fishing tournaments or tuna recreational fishing tournaments that also have a reward category for billfish. Few data from non-tournament sources are included in the RBS. Catches and landings of marlins are not limited to tournaments. Therefore, because the RBS is not a census and sport fishing landings of marlin are made outside of tournaments, the RBS-based estimates are considered minimal estimates.

This evaluation compares results from the RBS for 1999 with those of 1996. Data reported generally include at least: numbers of boats fishing in the tournament; dates of fishing; hours of fishing; and numbers of blue marlin, white marlin, and sailfish that were boated, released (without tagging), or tagged and released. Additionally, the weights and/or lengths of boated fish are generally recorded. Comparisons were first made for all tournaments recorded in both years, irrespective of whether the same number of tournaments, or even the same tournaments, were recorded in each year. There were 34% more tournaments reporting in 1999 (161 events) than reported in 1996 (120 events) owing at least in part to the fact that tournament registration became mandatory in the latter part of 1998 (and was fully implemented in 1999). Therefore, in order to more fully evaluate the effect of the new minimum size regulations, comparisons were also made for matched tournaments (those that took place in 1996 and again in 1999), or those that were from a time-area strata in 1999 considered sufficiently similar to be matched with one in 1996.

Data are tabulated and analyzed in two ways: (1) Number of fish; and (2) weight of fish. For comparisons by number of fish, data are compiled and tabulated, by species, for the following: numbers of fish boated, released, and tagged; percent boated and percent released (includes released plus tagged); CPUE in number of fish caught (i.e., boated + released + tagged) per 100 hours trolling effort; and

number of fish boated per 100 hours of trolling effort. In addition to determining the numbers of marlin landed in 1999 relative to 1996, a relative abundance scaling factor was derived in order to evaluate if the landing rates of blue marlin and white marlin were reduced by at least 25% in 1999 relative to 1996. The relative abundance in 1999 is calculated as the ratio of $CPUE_{1999}/CPUE_{1996}$. This factor is used to scale the 1996 boated rate for each species to the 1999 abundance equivalent, with 75% of that value (representing a theoretical 25% decrease in fish boated) then compared to the 1999 boated rate. Finally, the non-scaled percent reduction in the number of billfish boated (by species) in 1999 relative to 1996 is tabulated. This procedure was followed for all tournaments events in either year (Table 1) and then for the 94 matched events in both years (Table 2).

For the analysis by weight, individual fish data were compiled in decreasing length order for every blue marlin and white marlin boated. This facilitated determining the estimated total landings (t) for all events in both years and the percent reduction by weight in 1999 relative to 1996 (Table 3). The same procedure was followed for blue marlin for the 94 matched events in both years (Table 4), but due to the results for all events for both years for white marlin (Table 3), it was not necessary to do a matched events analysis for white marlin. Because the 99" LJFL minimum size ruling was not fully implemented for all of 1999 (as discussed in the Introduction), results are also presented comparing 1996 blue marlin landings with 1999 landings of fish at least 99" LJFL. This "perfect implementation" scenario also evaluates the reduction in 1999 relative to 1996 if no blue marlin were landed under 99" LJFL for both all events in both years (Table 5) and for the 94 matched events in both years (Table 6). It is worth noting that the many regulation changes implemented during 1998-1999 could have led to confusion in the fishing community and thereby caused blue marlin to be boated that were unintentionally undersized, in addition to fish that were incorrectly estimated to be at least minimum size. It was not necessary to consider a "perfect implementation" scenario for white marlin because of the results of the 1999 white marlin landings relative to 1996.

There were records of blue marlin and white marlin that had lengths but no weights in both fishing years. In those cases, regression equations were used to estimate weights (Prager *et al.* 1995). When there were no lengths or weights, a determination was made as to why those fish were missing sizes, based on records from the specific tournament. In almost all cases landed fish with no measurements had been undersized, and therefore disqualified and not weighed (or measured) under the tournament rules. We assigned all the fish missing sizes to be 1" under the appropriate minimum size regulation in effect at that time.

In both 1996 and 1999 several additional billfish, with measurements, were recorded as landed at a dock, and not as part of a tournament. These fish are included in the tables and analyzed by number and by weight, for all events in both years, and not for the matched events comparisons.

RESULTS

Analysis by Number of Fish – All Events

The NMFS Recreational Billfish Survey (RBS) documented data in 1996 from 120 tournaments, and in 1999 from 161 tournaments, from all areas combined (Table 1). The total effort recorded for these events was 89,525 h fishing in 1996 and 124,112 h fishing in 1999. This represents an increase in recorded tournament fishing effort of 39% associated with the increase of 34% in numbers of reported tournaments. The number of blue marlin recorded boated in 1999 decreased from 1996 from 208 to 177 ($Boated_{1999}/Boated_{1996}$ = 0.85, or a 15% reduction), and the number of white marlin recorded boated decreased from 74 to 36 (a 51% reduction) (Table 1, last column). For blue marlin, the percentage of fish caught which were boated (i.e., B/(B+R+T); B=boated, R=released, T=tagged) in 1999 (10.2%) was less than in 1996 (16.0%). For white marlin, the percentage of fish caught which were boated in 1999 (2.4%) was less than in 1996 (7.7%). The boated rate (# boated per 100 h effort) decreased from 0.232 to 0.143 blue marlin/100 h effort and from 0.083 to 0.029 white marlin/100 h effort, from 1996 to 1999. In

contrast, the total catch rates [CPUE (# fish/100 h trolling effort) = (B+R+T)*100/effort] for blue marlin were 1.450 in 1996 and 1.400 fish/100 h effort in 1999, and for white marlin were 1.069 in 1996 and 1.213 fish/100 h effort in 1999. After scaling the 1996 boated rate ($B/effort_{1996}$) by the relative abundance ratio of $CPUE_{1999}/CPUE_{1996}$, a comparison between 75% of $B/effort_{1996}$ and $B/effort_{1999}$ shows that: (a) For blue marlin, the decrease was greater than 25% (a 36% reduction; decreasing from 0.224 to 0.143 fish/100 h); and (b) for white marlin, the decrease was greater than 25% (a 69% reduction; decreasing from 0.094 to 0.029 fish/100 h).

Analysis by Number of Fish – Matched Events

There were 94 tournaments documented by the RBS that occurred in both 1996 and 1999 for all areas combined (Table 2). The total effort recorded for these events was 80,743 h fishing in 1996 and 99,074 h fishing in 1999. This represents an increase in recorded matched tournament fishing effort of 23%. The number of blue marlin recorded boated in 1999 decreased from 1996 from 183 to 163 ($Boated_{1999}/Boated_{1996}$ = 0.89, or an 11% reduction), and the number of white marlin recorded boated decreased from 66 to 35 (a 47% reduction) (Table 2, last column). For blue marlin, the percentage of fish caught which were boated (i.e., B/(B+R+T); B=boated, R=released, T=tagged) in 1999 (10.8%) was less than in 1996 (16.7%). For white marlin, the percentage of fish caught which were boated in 1999 (2.5%) was less than in 1996 (7.1%). The boated rate (# boated per 100 h effort) decreased from 0.227 to 0.165 blue marlin/100 h effort and from 0.082 to 0.035 white marlin/100 h effort, from 1996 to 1999. In contrast, the total catch rates [CPUE (# fish/100 h trolling effort) = (B+R+T)*100/effort] for blue marlin were 1.360 in 1996 and 1.530 fish/100 h effort in 1999, and for white marlin were 1.152 in 1996 and 1.391 fish/100 h effort in 1999. After scaling the 1996 boated rate ($B/effort_{1996}$) by the relative abundance ratio of $CPUE_{1999}/CPUE_{1996}$, a comparison between 75% of $B/effort_{1996}$ and $B/effort_{1999}$ shows that: (a) For blue marlin, the decrease (in scaled boated rate) was greater than 25% (a 35% reduction; decreasing from 0.255 to 0.165 fish/100 h); and (b) for white marlin, the decrease (in scaled boated rate) was greater than 25% (a 65% reduction; decreasing from 0.099 to 0.035 fish/100 h).

Analysis by Weight of Fish – All Events

The total estimated landings of blue marlin in 1996, based on 208 fish landed from the 120 tournaments sampled, was 32.4 t (Table 3). The total estimated landings of blue marlin in 1999, based on 177 fish landed from the 161 tournaments sampled, was 32.8 t. This represents an increase, by weight, of 1.2% compared to 1996 estimated levels. Though the number of fish landed decreased by 15%, the average weight of the landed catch increased (associated with the increase in minimum size regulations) by 19% (from 342.7 to 408.6 lb). As noted above, the reported effort (in h) increased by 39% in 1999 compared to 1996.

For white marlin, the total estimated landings in 1996, based on 74 fish was 1.99 t (Table 3). The total estimated landings of white marlin in 1999, based on 36 fish landed, was 0.95 t. This represents a decrease, by weight, of 47.7% compared to 1996 levels.

As noted above, the 99” LJFL minimum size rule was not implemented throughout 1999. Had there been perfect implementation of a 99” minimum size, and had no fish been landed under 99” in 1999, there would have been 141 fish recorded from all tournaments reporting – all with sizes (Table 5). The estimated average weight of the 141 fish was 439.3 lb, thereby yielding estimated landings of 28.1 t. This would represent a theoretical reduction of 13.3% in landed weight from the 1996 landings for all recorded tournaments. A reduction of 25% by weight to 24.3 t compared to 1996 would not have been achieved, with the shortfall being 3.8 t (= 28.1 – 24.3 t). To estimate the minimum size at which the 25% reduction by weight would have theoretically been attained in 1999, when comparing all recorded events, the size distribution of the recorded 1999 blue marlin landings was examined. It was determined that 116 fish were landed at sizes of 102” or above, with an associated estimated weight of 24.4 t. This tonnage equates to a 25% reduction from the 1996 recorded landings for all events.

Analysis by Weight of Fish – Matched Events

The total estimated landings of blue marlin in 1996, based on 183 fish landed from the 94 matched tournaments sampled, was 29.4 t (Table 4). The total estimated landings of blue marlin in 1999, based on 163 fish landed from the matched tournaments sampled, was 30.0 t. This represents an increase, by weight, of 2.0%. Though the number of fish landed decreased by 11%, the average weight increased (associated with the increase in minimum size regulations) by 15% (from 354.3 to 406.2 lb). As noted above, the reported effort (in h) for matched events increased by 23% in 1999 compared to 1996.

Because the decrease in the weight of white marlin landed in 1999 was >25% compared to 1996 (nearly 48%), no additional comparisons were tabulated for estimated landings of matched events for white marlin.

Had there been perfect implementation of a 99" minimum size, and had no blue marlin been landed under 99" in 1999, there would have been 128 fish recorded from the 94 matched tournaments – all with sizes (Table 6). The estimated average weight of the 128 fish was 438.6 lb, thereby yielding estimated landings of 25.5 t. This would represent a theoretical reduction of 13.3% in landed weight from the 1996 landings for matched tournaments. A reduction of 25% by weight to 22.1 t compared to 1996 would not have been achieved, with the shortfall being 3.4 t (= 25.5-22.1 t). To estimate the minimum size at which the 25% reduction by weight would have theoretically been attained in 1999 for matched events, when comparing all recorded events, the size distribution of the recorded 1999 blue marlin landings was examined. It was determined that 105 fish were landed at sizes of 102" or above, with an associated estimated weight of 22.0 t. This tonnage equates to a 25% reduction from the 1996 recorded landings for all matched events.

DISCUSSION

The primary objective of this analysis is to quantify the U.S. billfish landings in 1999 relative to 1996 and to evaluate whether the 1999 minimum size regulations for landing blue marlin and white marlin resulted in the reduction of U.S. marlin landings by 25%. As discussed in Farber and Venizelos (1999), when comparing data from the most recent year with an earlier year, it must be recognized that many of the tournaments were held annually, and reported in both years. At the same time new billfish events are constantly organized, while some events are discontinued or change name and/or location. Additionally, reporting was voluntary until 1999. Some events may or may not have reported in any given year. Many more events were documented in 1999 (161) than in 1996 (120) due to mandatory tournament registration by the NMFS being fully implemented in 1999. Therefore, the results in this evaluation were tabulated in two ways: (1) Comparing data from all recorded events in both years (Tables 1, 3, and 5), irrespective as to whether the events occurred in both years; and (2) comparing matched events that occurred in both years (Tables 2, 4, and 6). Further, the ICCAT Recommendation objective was to reduce "*landings* by at least 25% for each species from 1996 landings." Because there was no specification as to whether these landings were to be compared in numbers or weight, we analyzed landings from both perspectives (numbers and weight) and comment on several approaches that can be used for evaluating the success of meeting the 25% reduction objective.

The recorded effort (in h trolling) in 1996 and 1999 for the 94 matched events represented 90% of the total effort recorded by the 120 tournaments in 1996 and 80% of the total effort in the 161 tournaments in 1999. The results of these matched events that occurred in both years (Table 2), are generally similar for blue marlin to those comparing the 120 events in 1996 with the 161 reported events in 1999 (Table 1). The number of blue marlin recorded boated in 1999 decreased 15% and 11% from the recorded 1996 levels for all events and matched events, respectively (Tables 1 and 2, last column). In both cases, the percentage of blue marlin boated in 1999 (about 10%) was less than in 1996 (about 16%). This decrease in absolute numbers does not meet the 25% reduction objective, but this approach does not take into consideration the very large overall increase in recorded effort from 1996 to 1999 for all events due to

mandatory tournament registration beginning in 1999 (almost 39% - 89,525 to 124,112 h). The abundance adjusted boating rate for blue marlin in 1999 decreased by about 35% (Tables 1 and 2, penultimate column) from 1996 for all events (0.224 to 0.143) and for matched events (0.255 to 0.165). If one was to use this boating rate (in number of fish) as a "measure of success" towards meeting a 25% reduction in 1999 relative to 1996 for blue marlin, then the goal would be surpassed.

The results of the matched events and all events are generally similar for white marlin. The number of white marlin recorded boated in 1999 decreased 51% and 47% from the recorded 1996 levels for all events and matched events, respectively (Tables 1 and 2, last column). In both cases, the very small percentage of white marlin boated in 1999 (about 2%) was less than in 1996 (about 7%). This decrease in absolute numbers far exceeds the 25% reduction objective without any consideration of the very large overall increase in recorded effort from 1996 to 1999 for all events. The abundance adjusted boating rate for white marlin in 1999 decreased by 69% (Table 1, penultimate column) from 1996 for all events (0.094 to 0.029) and by 65% for matched events (0.0995 to 0.035). Using this boating rate (in number of fish) as a measure of success towards meeting a 25% reduction in 1999 relative to 1996 for white marlin, then the goal was exceeded.

As noted above, the total number of blue marlin landed decreased by 15% (208 to 177) while the overall recorded effort (in h) increased by 39%. However, when considering landings of blue marlin by weight, the increased minimum size in 1999 generated an increased average weight for all events and for matched events. This increase was sufficient to produce an estimated increase in 1999 landings by weight for blue marlin (1.2% for all events and 2.0% for matched events – Tables 3 and 4). Therefore, if using the weight of blue marlin landed as the measure of success towards meeting a 25% reduction, the goal was not achieved; in fact there was a slight increase in landing weight.

For white marlin, the 51% decrease in number landed, in concert with a very slight decrease in the associated average weight (59.4 to 58.3 lb), generated a reduction in the 1999 landings by weight of 48%. As a measure of success this far exceeds the goal.

The reason for analyzing a hypothetical "perfect implementation" scenario in 1999 for blue marlin was to demonstrate the potential results had the 99" minimum size regulation been in effect for the U.S. recreational fishery all year. U.S. fishery managers had determined that the means to affect at least a 25% reduction in landings in 1999 relative to 1996 was by increasing the minimum size (Anonymous, 1999). However, to evaluate whether this goal was accomplished requires realizing that the strategy of a 99" minimum size for blue marlin was not fully implemented in 1999 and that the comparisons are made between a year with historically no required tournament registration (1996) and the year with full mandatory registration required (1999). Additionally, the degree to which this result applies to future landings relates to changes in the underlying population size structure and relative abundance as well as the effort applied in future tournaments. Increases in future relative abundance of fish above the indicated sizes given fixed fishing effort could result in lower potential reductions than indicated. Similarly, increases in fishing effort, given stable relative abundance at size could also result in lower potential reductions. Lastly, interpretation of the results is predicated on whether landings are analyzed in numbers of fish or by total weight.

CONCLUSION

It appears that the methodology of a simple comparison of numbers or weight, without some standardization relating to the large increase (39%) in reported effort (which may or may not represent a real increase in effort) would be biased because of the major change in tournament reporting requirements between 1996 and 1999. However, addressing the question as to whether U.S. recreational marlin landings for all recorded tournaments in 1999 were at least 25% below the 1996 landings, irrespective of whether they were matched events in both years, the following conclusions are made:

Blue marlin

(1) Decrease in numbers boated in 1999 compared to 1996 was 15% (208 to 177 fish).
(2) Decrease in boating rate (# boated/100 h effort) in 1999 compared to 1996 was 38% (0.232 to 0.143).
(3) Decrease in boating rate in 1999 compared to 1996 when scaled by relative abundance factor was 36% (0.224 to 0.143).
(4) Increase in estimated weight of landings in 1999 compared to 1996 was 1% (32.4 to 32.8 t).
(5) Had the 99" minimum size regulation been in effect throughout 1999, with perfect implementation, the estimated landings in 1999 compare to 1996 would have decreased by 13% (32.4 to 28.1 t).

White marlin

(1) Decrease in numbers boated in 1999 compared to 1996 was 51% (74 to 36 fish).
(2) Decrease in boating rate (# boated/100 h effort) in 1999 compared to 1996 was 65% (0.083 to 0.029).
(3) Decrease in boating rate in 1999 compared to 1996 when scaled by relative abundance factor was 69% (0.094 to 0.029).
(4) Decrease in estimated weight of landings in 1999 compared to 1996 was 48% (1.99 to 0.95 t).

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Table 1. For all areas combined, the 1996 and 1999 billfish recorded by the NMFS Recreational Billfish Survey (RBS). All reported data are included from 120 tournaments in 1996 and 161 tournaments in 1999. Total recorded effort (h trolling) was: 89,525 h in 1996 and 124,112 h in 1999. B = Boated; T = Tagged; R = Released. The relative abundance between years is calculated by the ratio of CPUE (1999) / CPUE (1996), which in turn is used to scale the 1996 boated rate (B/effort). 75% of the scaled (i.e., abundance adjusted) 1996 boated rate is compared to the 1999 boated rate. Note: Sailfish data are tabulated but not incorporated into this analysis.

Effort (h trolling):

1996	89,525
1999	124,112

Species	# Boated * 1996	# Boated ** 1999	# Released 1996	# Released 1999	# Tagged 1996	# Tagged 1999	TOTAL = B+R+T 1996	TOTAL = B+R+T 1999
BLUE MARLIN	208	177	660	443	430	1117	1298	1737
WHITE MARLIN	74	36	738	736	145	733	957	1505
SAILFISH	57	30	1966	1499	452	486	2475	2015

Species	% Boated = B/(B+R+T) 1996	% Boated = B/(B+R+T) 1999	% Released = (R+T)/(B+R+T) 1996	% Released = (R+T)/(B+R+T) 1999	CPUE (#/100 h) = (B+R+T)/effort 1996	CPUE (#/100 h) = (B+R+T)/effort 1999	Boated/100 h = B/effort 1996	Boated/100 h = B/effort 1999
BLUE MARLIN	16.0%	10.2%	84.0%	89.8%	1.450	1.400	0.232	0.143
WHITE MARLIN	7.7%	2.4%	92.3%	97.6%	1.069	1.213	0.083	0.029
SAILFISH	2.3%	1.5%	97.7%	98.5%	2.765	1.624	0.064	0.024

Species	Rel. Abund. = $CPUE_{1999}$ / $CPUE_{1996}$	Scaled 1996 = Rel. Abund. X B/effort 1996	75% of Scaled 1996	Boated/100 h = B/effort 1999	Was 1999 B/effort?? or ?? 75 % of Scaled 1996 Rate?	% Reduction in # Boated in 1999 Relative to 1996
BLUE MARLIN	0.965	0.224	0.168	0.143	yes (36% reduction)	15%
WHITE MARLIN	1.134	0.094	0.070	0.029	yes (69% reduction)	51%
SAILFISH	0.587	0.037	0.028	0.024	yes (35% reduction)	47%

* Includes 3 blue marlin and 2 white marlin recorded as landed at docks with reported weight but no associated effort.
** Includes 2 blue marlin recorded as landed at docks with reported weight but no associated effort, and 2 reported as dead and discarded.

Table 2. For all areas combined, from the NMFS Recreational Billfish Survey (RBS), for the 94 tournaments that were recorded in both 1996 and 1999. Total recorded effort (h trolling) was: 80,743 h in 1996 and 99,074 h in 1999. B = Boated; T = Tagged; R = Released. The relative abundance between years is calculated by the ratio of CPUE (1999) / CPUE (1996), which in turn is used to scale the 1996 boated rate (B/effort). 75% of the scaled (i.e., abundance adjusted) 1996 boated rate is compared to the 1999 boated rate. Note: Sailfish data are tabulated but not incorporated into this analysis.

Effort (h trolling):

1996	80,743
1999	99,074

Species	# Boated 1996	# Boated * 1999	# Released 1996	# Released 1999	# Tagged 1996	# Tagged 1999	TOTAL = B+R+T 1996	TOTAL = B+R+T 1999
BLUE MARLIN	183	163	506	427	409	926	1098	1516
WHITE MARLIN	66	35	729	684	135	659	930	1378
SAILFISH	54	23	1251	1269	398	373	1703	1665

Species	% Boated = B/(B+R+T) 1996	% Boated = B/(B+R+T) 1999	% Released = (R+T)/(B+R+T) 1996	% Released = (R+T)/(B+R+T) 1999	CPUE (#/100 h) = (B+R+T)/effort 1996	CPUE (#/100 h) = (B+R+T)/effort 1999	Boated/100 h = B/effort 1996	Boated/100 h = B/effort 1999
BLUE MARLIN	16.7%	10.8%	83.3%	89.2%	1.360	1.530	0.227	0.165
WHITE MARLIN	7.1%	2.5%	92.9%	97.5%	1.152	1.391	0.082	0.035
SAILFISH	3.2%	1.4%	96.8%	98.6%	2.109	1.681	0.067	0.023

Species	Rel. Abund. = $CPUE_{1999}$ / $CPUE_{1996}$	Scaled 1996 = Rel. Abund. X B/effort 1996	75% of Scaled 1996	Boated/100 h = B/effort 1999	Was 1999 B/effort?? or ?? 75 % of Scaled 1996 Rate?	% Reduction in # Boated in 1999 Relative to 1996
BLUE MARLIN	1.125	0.255	0.191	0.165	yes (35% reduction)	11%
WHITE MARLIN	1.208	0.099	0.074	0.035	yes (65% reduction)	47%
SAILFISH	0.797	0.053	0.040	0.023	yes (57% reduction)	57%

* Includes 2 blue marlin reported as dead and discarded.

Table 3. All recorded blue marlin and white marlin landed in 120 tournaments in 1996 and 161 in 1999. Minimum size in 1996 was 86". In 1999, minimum size regulations varied from 86" to 99" LJFL. See Introduction for details.

Blue Marlin:

	# Landed	# Weighed *	Estimated average weight (lb)	Estimated Landings (t)	Target at 25% reduction (t)	% Reduction in 1999 Relative To 1996
1996	208	189	342.7	32.4	-	-
1999	177	174	408.6	32.8	24.3	+ 1.2%

White Marlin:

	# Landed	# Weighed *	Estimated average weight (lb)	Estimated Landings (t)	Target at 25% reduction (t)	% Reduction in 1999 relative to 1996
1996	74	72	59.4	1.99	-	-
1999	36	36	58.3	0.95	1.49	- 47.7%

* Some weights estimated from length using Prager *et al.* (1995).

Table 4. All recorded blue marlin landed in 94 matched tournaments in 1996 and 1999. Minimum size in 1996 was 86". In 1999, minimum size regulations varied from 86 " to 99" LJFL. See Introduction for details.

Blue Marlin:

	# Landed	# Weighed *	Estimated Average Weight (lb)	Estimated landings (t)	Target at 25% reduction (t)	% Reduction in 1999 Relative to 1996
1996	183	176	354.3	29.4	-	-
1999	163	160	406.2	30.0	22.1	+ 2.0%

* Some weights estimated from length using Prager *et al.* (1995).

Table 5. Hypothetical landings of blue marlin from all tournaments in 1996 and 1999 if perfect implementation had been in effect throughout 1999.

Blue Marlin:

	# Landed	# Weighed *	Estimated average weight (lb)	Estimated Landings (t)	Target at 25% reduction (t)	Theoretical % reduction in 1999 relative to 1996
1996	208	189	342.7	32.4	-	-
1999	141	141	439.3	28.1	24.3	- 13.3%

* some weights estimated from length using Prager *et al.* (1995)

Table 6. Hypothetical landings of blue marlin from matched tournaments in 1996 and 1999 if perfect implementation had been in effect throughout 1999.

Blue Marlin:

	# Landed	# Weighed *	Estimated average weight (lb)	Estimated landings (t)	Target at 25% Reduction (t)	Theoretical % reduction in 1999 relative to 1996
1996	183	176	354.3	29.4	-	-
1999	128	128	438.6	25.5	22.1	- 13.3%

* some weights estimated from length using Prager *et al.* (1995)