

A Socioeconomic and Biological Assessment of a Constituent-based Tag Data Collection Program

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ABSTRACT

The past decades have witnessed both a rise in the popularity of big game Sportfishing and concern over decreasing numbers of large pelagic fish. In response, The Billfish Foundation (TBF), a non-profit, science-based organization, created a Tag and Release Program, reliant upon the recreational community, to assist in determining attributes pertaining to billfish stocks, life history, and migratory patterns. Scientists and policy makers have used the data gathered to guide fisheries management regulations and research. The objective of this paper is to assess TBF's Tag and Release Program and determine how it may be improved. Analysis of the program includes investigation of the historical background of the TBF's Tag and Release Program and appraisal of the program's database. This included examination of the current data collected, assessment of the accuracy of that data and review of the processes involved in the program. While the appraisal validates that TBF has one of most comprehensive recreational billfishing databases available to scientists and regulators, it also highlights areas of necessary improvement. These improvements would increase the value of the database by providing a more effective tool for stakeholders to better understand billfish and the billfishing community.

KEYWORDS: The Billfish Foundation, TBF's Tag and Release database, socioeconomic data, biological data

Una Evaluación Socioeconómica y Biológica de un Programa de Marcaje Basado en la Participación de los Usuarios

Con el aumento en popularidad de la pesca recreacional del pez vela en el último siglo y una mayor preocupación acerca de la disminución de los grandes peces pelágicos, la fundación del Pez Vela (TBF), una organización sin fines de lucro, creó un programa de marcaje y lanzamiento basado en la participación de los pescadores recreacionales para asistir a determinar los números de pez vela, historia de vida, y los movimientos. Los científicos y administradores de este recurso han utilizado los datos recopilados para dirigir regulaciones y las investigaciones de esta pesquería. El objetivo de este trabajo fue la evaluación del programa de marcaje y lanzamiento de la fundación del Pez Vela (TBF) y determinar qué se podría hacer para mejorar el programa. El análisis del programa incluye: (1) investigación de los antecedentes históricos pesca recreacional del pez vela; (2) comprensión de la valuación del pez vela; (3) evaluando las regulaciones establecidas para la protección del pez vela; y (4) evaluación de la base de datos de marcaje y del lanzamiento de la TBF. Esta examinación incluye evaluación de los datos recogidos hasta el momento evaluación de la exactitud de eso los datos y revisión de los procesos implicados en el programa. Mientras que la valoración valida que TBF tiene una de las bases de datos acerca de la pesca del pez vela recreacional más completa y comprensivas disponibles para los científicos y los administradores del recurso, también destaca áreas que necesitan mejorarse. Estas mejoras aumentarían el valor de la base de datos proporcionando una herramienta más eficaz para que los usuarios entiendan mejor la pesca del pez vela y a la comunidad de pescadores recreacionales del pez vela.

PALABRAS CLAVES: La fundación del Pez Vela, marcaje convencional, base de datos

Evaluation Socio-économique et Biologique d'un Programme de Collecte de Données Basé sur une Méthode de Marquage-relargage

Avec le succès grandissant de la pêche récréative au siècle dernier et l'intérêt croissant concernant la baisse du nombre des grands pélagiques, la fondation « BillFish », une organisation scientifique à but non lucratif, a créé un programme de marquage-relargage impliquant les pêcheurs de loisir pour aider au choix du nombre de poissons, de leur vie et de leurs déplacements. Les scientifiques et les décideurs ont utilisés ces données pour orienter les règlements de la gestion des pêches et la recherche. L'objectif de ce papier est d'évaluer le programme marquage-relargage de la fondation Billfish (TBF) et de déterminer ce qui pourrait être fait pour améliorer ce programme. Une analyse de ce programme incluait : (1) d'analyser le contexte historique de l'intérêt de la pêche récréative lucrative, (2) de comprendre la valorisation de cette pêche ; (3) d'évaluer les règles existantes pour la protection de cette pêche, et (4) d'évaluer la base de données du programme marquage-relargage de la TBF. Cela incluait l'analyse des données déjà collectées, l'évaluation de leur exactitude ainsi que les processus impliqués dans ce programme. Bien que l'évaluation valide le fait que TBF possède l'une des bases de données les plus complètes disponibles pour les scientifiques et les gestionnaires, elle met en évidence des zones d'améliorations indispensables. Ces améliorations augmenteraient la valeur de la base de données en fournissant un outil plus efficace pour les parties prenantes afin de mieux comprendre la pêche récréative et la communauté des pêcheurs récréatifs.

MOTS CLÉS: Fondation Billfish, programme marquage-relargage

INTRODUCTION

From anglers and boat owners to government regulators, billfish attract a diversity of stakeholders and user groups. Such interest increases the importance of knowledge of movements, growth rates, and stock abundance for conservation and management purposes. To these ends, and to increase management efficacy, stakeholders like The Billfish Foundation (TBF) launched programs (TBF's Tag and Release Program) to acquire information that will help them understand more about billfish stocks. TBF's Tag and Release Program collects important biological and socioeconomic data from the recreational fishing community and provides that information to the public.

This paper analyzes a collection of TBF's early billfish data and compares it to the current data collected to decipher and illustrate which data fields provide most value to policy makers and scientists. This report examines attributes related to evolution of the need for billfish data, methods of data collection, and those related to the current dataset. Furthermore, it suggests improvements be made on TBF's Tag and Release Program to allow for processes that are more efficient and more valuable data collection. A comprehensive billfish database is a crucial element in measuring current billfish regulatory effectiveness, prescribing future billfish regulations, and elucidating future trends in the billfishing industry.

THE BILLFISH FOUNDATION

The Billfish Foundation (TBF) is a non-profit, science-based organization dedicated to the conservation of billfish and the preservation of recreational fishing rights. TBF combines the knowledge of anglers' with that of the scientific community to create solutions for billfish conservation management. Thus, TBF acts as a liaison between recreational fishing interests, regulators, and the various stakeholders for the fishery. The Billfish Foundation's constituency consists of sportfishing interests, research scientists, and socio-economic policy makers. TBF gathers information from diverse constituents and formulates a united voice for sportfishing and billfish conservation.

TBF aims to educate anglers and report to advise regulatory bodies to foster cooperation in order to help sustain a healthy billfish stock for future use and enjoyment. TBF represents recreational fishing interests in regional, national and international management bodies. TBF actively addresses the causes of billfish decline through the promotion and advocacy of less harmful equipment and better fishing ethics to perpetuate equitable intergenerational distribution of billfish resources through time. One of TBF's most successful and longest standing programs has been the Tag and Release Program. This program provides billfish stakeholders with a central dataset for evaluation and formulation of policy.

HISTORY OF THE BILLFISH FOUNDATION'S TAG AND RELEASE PROGRAM

The cornerstone of TBF's work is the constituent-based Tag and Release Program that began in 1990. This unique program utilizes anglers' love of fishing and allows them to participate in billfish conservation. The use of the recreational sector is important because recreational billfishing is popular internationally. The Tag and Release Program is voluntary and relies on the anglers to tag, release, and then record their billfish data. Scientists use the information gathered by the anglers to help fill in any biological to socioeconomic gaps in billfish research. Growth rates and times at large provide biological data, while gear type and vessel information provide socioeconomic data.

TBF's use of a constituent-based tag and release data has many important advantages. Two of the most important factors are the "low-cost" to scientists and the elimination of logistical concerns. Utilizing the data that is being collected by those who are already fishing saves scientists from having to procure funds for vessel use, buying tagging equipment, traveling to popular billfish locations, etc. Additionally, billfish anglers have local and traditional knowledge of the region. This knowledge can range from where billfish are typically seen, to what bait is best for catching certain billfish. For billfish scientists, the utilization of the data collected from the anglers is invaluable.

The tag and release data collected from the anglers provides a multitude of essential biological information. Valuable biological data is derived from recaptured billfish data. Upon capture, anglers are asked to record a variety of different data fields, i.e. weight, length, location and species of billfish on either or tag or release card (Figures 1 and 2). By looking at the locations of a tag or release, TBF can determine the spatial distribution of species. By comparing the original tagging data to the recaptured data, scientists can measure growth rate, movement patterns, and other attributes.

Biological data should not overshadow the importance of socioeconomic data collected from the billfish anglers. This data is of import to those directly or indirectly involved in billfishing as it can be used to determine demographics of fishermen, fishing effort, expenditures, gear type, and effectiveness and efficiency of outreach measures. TBF's database can measure boat days as an input of fishing effort. For example, if five boats fish off Key West for five days, they would have expended 25 boat days of effort. Comparing boat days to catch rates of billfish can determine catch per unit effort (CPUE), a common metric of fisheries analysis. The Billfish Foundation can also plot how many anglers use non-offset circle in relation to those employing "J" hooks. Socioeconomic data can be used in policy evaluation.

This clearly demonstrates how important the collection and interpretation of socioeconomic data is to governing

bodies like the U.S. government or an international governing body like the International Commission for the Conservation of Atlantic Tuna (ICCAT). Understanding the importance of socioeconomic data can lead to more policy that is effective because it gives the policy makers an understanding of all the stakeholders. Recognizing the value of billfishing is a critical component of billfish conservation. Both types of data collected by the Program are significant: biological data can help scientists and socio-economic data can gauge effort to direct decisions about the anglers the fishery and steer policy.

The data retrieved by the anglers provides scientists and policymakers a better understanding of the real time plight of billfish and helps to fill in existing gaps in management (i.e. valuation of fishery). It is estimated that 50 – 80% of what is known about the billfish fishery is derived from conventional tagging data, like TBF's Tag and Release Program (Hilborn *et al.* 1990). Conventional tagging utilizes the low cost "spaghetti-style" tags versus the more expensive and larger satellite tags which cost \$3500 U.S. dollars apiece. While both tagging techniques are used, TBF's Tag and Release database exclusively relies on traditional spaghetti tagging technology.

TBF is not the only organization to employ a tagging program that utilizes angler participation. Various international entities, the New South Wales Game Fish Tagging Program in Australia and NMFS in Miami, Florida in the United States, utilize similar programs. While both programs preceded TBF, (New South Wales in 1973 and NMFS program in 1954 respectively), TBF's Tag and Release Program exhibits the largest number of users. Moreover, while most of these programs address similar data sets in terms of movement and growth rate, by requesting information such as size and homeport of vessels, frequency of fishing trips per location, etc TBF gleans more socioeconomic information than other programs. Furthermore, TBF's tagging data is retrieved on international and global scales, while the other tagging programs tend to be focused regionally based. TBF is working to expand data collection efforts by distributing tagging equipment into various parts of Asia, Central America, Africa, and South America.

METHODS

The aim of the project was to determine whether TBF's Tag and Release Program is effective and proficient in the collection of billfish data. The first analysis examined the current processes of data collection of TBF's Tag and Release Program, specifically to determine what kind of data was being collected.

TBF's Tag and Release Logistics Details and Database

TBF's Tag and Release database exhibits three different categories of input event; tag, release, and recapture. A tagging event describes an angler implanting a TBF conventional tag into a billfish and releasing the fish

alive. A tagged fish is different from just a released fish, because a "release" does not include the implanting of a tag by the angler. A recapture is the recovery of a previously tagged billfish either dead or alive. Although the three data categories are similar in some aspects because they involve the capture of a billfish, they provide various types of information to TBF and its scientists.

Before tags can be issued, a Billfish Tag Issue Report Card must be filled out (Figure 3) and mailed to TBF. This card allows TBF to track who purchased the tags, by looking at the series of tag numbers associated to the name written on the card. If there is any missing original tagging data for a recaptured fish, this allows TBF to identify and contact the person who purchased them and perhaps where the tags were deployed.

Ideally, billfish anglers bring the billfish to the boat to try to remove the hook and release the fish with minimal harm. Rather than releasing the fish immediately, an angler implants a small "spaghetti" style (medical-grade hydroscopic) conventional tag on the fish using a stainless steel applicator point on a hard plastic pole. Once the billfish is released, the angler records the information on a pre-addressed data card (Figure 1) and mails it to TBF.

While the tagging data retrieved from TBF's Tag and Release Program is important, the release data should not be overlooked. The release data is collected similarly to the tags (Figure 2), but include more socioeconomic questions, including catch per-unit-effort (CPUE). The release aspect of the program is relatively new to TBF with the distribution of the cards, beginning in 2003. Unlike tags, the release cards are free. Charter fleets typically receive them, since they provide access to many anglers. Release cards are provided to those who do not have tags and would still like to participate in the program.

The last data category is the recapture information. While the data is similar to tag data, recapture data is crucial information collected by TBF's Tag and Release database for TBF and its scientists. Typically, an angler or captain will mail in or call TBF based on the information

Figure 1. A recent version TBF's Tag Card

provided on the tag with information on the recaptured billfish. While a majority of the recaptured fish come from commercial fleets and artisanal fishermen that “land” or kill the fish, the recapture provides important data, allowing TBF to “close the circle” from when the fish was originally caught to when it was recaptured. Analysis of these data can determine growth rates, life spans, and migratory patterns.

Figure 2. A recent version of TBF's Release Card.

Once TBF receives the tag and release data from its constituents, staff and volunteers process the data into the tag and release database. This database houses all of the data collected from 1990. Since 2004, the database utilizes a customized software program built by an outside company. The change in database systems allows for more expansive and complex queries, creation of new data fields in the database, and wider use by TBF's constituents. Before the introduction of the new database, TBF could only gather and decipher limited data from the tag and release cards. The transition also made it possible for TBF to enter the billfish data anywhere with an Internet connection (which was previously possible only from TBF offices). Once the information from tag, release, and recapture events is processed, trends in the data collected are isolated by electronic queries. Information from TBF's Tag and Release database is used for various publications, scientific research, education and advocacy efforts. This use illustrates the importance of accurate date incorporation.

Efforts to Evaluate Billfishing's Socioeconomic Value

Before the recent recognition of the importance of socio-economic data, most of the information collected was biological information. The development and implementation of policies remiss of the value of the billfish to recreational angler and its impact to local communities has at times led to conflict and failed policies. TBF has realized the importance of incorporating socioeconomics in

the public debate. Moreover, it has made strides to collect additional socioeconomic data to assist managers in shaping billfish policies.

Understanding the true economic value of the recreational billfish fishery is complex due to the inability to price the recreational fishing experience. Having no market price makes estimating a user's benefits and behavior (demand) challenging. It is important to understand that a fishing trip has much greater value than the costs associated with getting to, using, and returning from the resource. There are many attributes or facets to these non-marketable goods like angler's skill, as well as “quality time” spent with family and friends, and being on the ocean. These aspects of billfishing add to its cachet and make billfishing worth more than the expenditures. Due to the absence of markets for these experiences, economists have drawn on stated preference valuation and revealed preference methods to estimate the value of recreational fishing activities.

Stated preference valuation illustrates people's directly stated value in a hypothetical market. Contingent valuation (a commonly used stated preference method) is done in a questionnaire form by asking a user how much they would be willing to pay for a certain service or good in a hypothetical scenario. Typically, this method asks how much a user is willing to pay for an improvement or for prevention of decline in catch. Once the surveys are completed, the average willingness to pay is multiplied by the population of the users to determine the net consumer surplus. This can be informative because it can assist in determining willingness to pay in the context of billfish regulations and management strategies.

Contingent valuation is popular because of its simplicity to both researchers and respondents. Although it is popular, it is susceptible to several factors:

- i) Incentives that can misrepresent preferences (strategic and compliance),
- ii) Misunderstandings of the non-market good, and
- iii) Response bias based on the questionnaire.

Nevertheless, the method is used because its simple and many complex conclusions can be drawn from that data acquired.

By using contingent valuation, Ditton and Stoll were able to measure the value and the economic importance of billfishing. They determined that the consumer's surplus to maintain current billfish populations in the U.S. Atlantic to be \$497 U.S. dollars per billfish angler per year in the U.S. Atlantic and \$480 U.S. dollars in Puerto Rico. They also reported that the willingness-to-pay for maintaining current billfish populations is \$3.93 million in the U.S. Atlantic and \$0.78 million in Puerto Rico. The aggregate direct impact of billfish expenditures is estimated to be \$15.13 million for the U.S. Atlantic and \$32.40 million for Puerto Rico. Thus, the total economic value of billfish angler fishing is estimated to be \$19.06 million per year for

the U.S. Atlantic and \$33.18 million per year for Puerto Rico (Ditton and Stoll 2003).

Revealed preference method is another type of non-market valuation that measures the economic use value for recreational activities. Revealed preferences are exposed through actual behavior but are subject to data limitations. Revealed preference method has multiple representations:

- i) Basic travel cost method,
- ii) Multiple-site travel cost models, and
- iii) Random utility modeling.

The basic travel cost method, is a popular revealed preference method that uses information regarding the total costs of the actions to the anglers going billfishing in a real market. It assumes a relationship between the environmental good and the market. Managers use this method to determine the threshold of the consumer's willingness to pay to do an activity in a certain area.

For policy purposes, it is important to realize that while expenditures are essential to understand local economic impacts, which essentially capture the flow of money in a community, they are not a valid measure of the trip's true economic worth. There are reasons why expenditures or economic impacts analysis is not the preferable alternative for billfishing valuation.

TBF's Tag and Release database can assist in identifying the variables that can determine the value of billfishing for a region using a revealed preference method, such as the travel cost method. For example, economists can use TBF's data to measure fishing site data by observing how far anglers travel to a particular site and then convert that data to determine the travel cost. That would reveal how valuable a particular site is in relation to others. The TBF provides valuable information for the development of a travel cost analysis such as:

- i) Distance traveled and expenditures, including opportunity cost of time,
- ii) Number of visits to locale,
- iii) Traveling time,
- iv) Substitute sites, and
- v) Environmental/fishing quality of locale.

From these variables, economists can measure the amount of satisfaction (consumer surplus) the consumer receives when they go on a trip.

RESULTS

TBF's Tag and Release Program Strengths

Relative to other tagging databases, the TBF Tag and Release database is young. Nevertheless, it has opened many avenues for tag and release participation since its inception in 1990, with over 140,000 billfish tagged and more than 30,000 release incidences. With broad geographical distribution and data collected from its constituents internationally, TBF's Tag and Release Program

popularity has grown. In this past year, TBF's Tag and Release Program has reached new localities such as Thailand, Pakistan, Japan, Fiji, and Independent Samoa. The addition of new locations, a continued strong presence in the Western Hemisphere has greatly enhanced TBF's Tag and Release database.

The high number of tag and release cards received from TBF's constituents provides significant amount of biological billfish data (Tables 1 and 2). This biological billfish data is the backbone of TBF's Tag and Release database. TBF has conferred with various scientific constituents, like NMFS, to determine what to ask for in their tag and release cards. The biological data recorded by the anglers (weight, length, species, location, etc.) give scientists the necessary information to fill in any gaps of biological billfish knowledge. Furthermore, since a large number of anglers take part in TBF's Tag and Release Program, TBF has some of the highest percentages of recaptured tagged billfish. Additionally, TBF annually reports tag and release data to the National Marine Fisheries Service, strengthening the NMFS database.

Because TBF is a recreational angler-based group rather than a government-run organization like NMFS, it enjoys higher rates of angler participation. Anglers are traditionally wary of government agencies and how these agencies utilize their data. Anglers have expressed concern that this could be assisting the commercial fleets in identifying fishing grounds, giving commercial fishermen an advantage. Anglers perceive greater value in supporting TBF programs because of the history of policy work and the public recognition TBF gives the angler in terms of annual competitions, certificates of achievement (Figure 4), and participation in tournaments and angler functions

Another strength of the program has been the large amount of data received by TBF's tag and release database and its customizable features. The planned addition of a more customizable database allows TBF or any of their scientists to customize specific data queries that fit their needs. This is apparent in TBF's Annual International Conservation Record book that highlights any new trends in their data like new billfish tagging locations (Figures 7 and 8).

TBF has established that recognition of catching and releasing a billfish can educate anglers on the importance of the catch and release fishing ethic, as well as add to the reputation of billfishing. TBF offers additional "rewards" for a successful tag and release of billfish - i.e. TBF's Release Certificate, TBF's Tag and Release Competition and TBF's Recapture rewards. These incentives keep the anglers and captains excited about the Tag and Release Program.

TBF's Release Certificate (Figure 4) recognizes an angler and captain on their successful tag and/or release of a billfish. The release certificate is truly valued by anglers and captains and is one way that TBF keeps their "volunteer" tagging program operating successfully. These

certificates allow the angler to display what they caught, but also serve as a tool for getting anglers to properly fill out the data.

Moreover, the recorded billfish data for that year qualifies the captain, mate and angler for TBF's Annual Tag and Release Award Competition. The competition categories highlight the top tagging and release angler, captain, youth angler and mate for the three major ocean bodies and draw some of the top billfish anglers and captains in the world. Like TBF's release certificate, the awards given at the Annual Tag and Release Awards Ceremony are prized.

Anglers and captains who call the TBF office regarding a recaptured billfish receive a reward. The billfish tags not only have TBF's phone number and email but also have marked "Reward" in English and Spanish to facilitate contacting TBF. The rewards given to the angler and captain are TBF recapture t-shirts, TBF Recapture Certificate, and information on the original data collected. It is important to understand how these awards can drive the recreational community and how they help TBF achieve its conservation goals.

Table 1. Yearly breakdown of release cards received
Yearly Species Release Breakdown

	2003	2004	2005	2006	Total
Black Marlin	0	0	52	94	146
Blue Marlin	3	1522	327	425	2277
Spearfish	0	0	6	16	22
Sailfish	16	4934	3262	4910	13122
Swordfish	0	0	16	22	38
White Marlin	21	476	171	141	809
Striped Marlin	5	2458	2792	4642	9897
Total	45	9390	6626	10250	26311

Table 2. Yearly breakdown of tag cards received.
Yearly Species Tag Breakdown

	2003	2004	2005	2006	Total
Black Marlin	226	389	325	316	1256
Blue Marlin	1994	2088	1757	1662	7501
Spearfish	157	140	113	98	508
Sailfish	4272	2840	3546	2606	13264
Swordfish	87	68	104	102	361
White Marlin	453	608	407	486	1954
Striped Marlin	1089	1104	1975	1159	5327
Total	8278	7237	8227	6429	30171

Recognition of Problems in TBF's Tag and Release Program

A literature review and interviews with TBF staff and its constituents helped to determine the efficiency of the program and the extent of biological and socioeconomic data in TBF's Tag and Release database. After careful analysis, it was determined that improvements could be made to TBF's Tag and Release Program to achieve higher data quality and encourage increased participation from the billfishing community. While the new database program offered more customization for TBF, areas for enhancement were identified. TBF has made improvements to the data coming in and out of the database and the procedures for data entry. TBF went "live" online, as it began to develop the new data system. This was a learning process as the database was/is being developed with outside assistance and TBF had to communicate to non-anglers complex fishing procedures and gear. The two types of issues identified dealt with the processes and then with the actual database. The issues identified within the database are currently minor ones, but they could grow into something larger if not addressed.

Problems with Various Processes in TBF's Tag and Release Program

The issues associated with TBF's Tag and Release Program were: data processing with the improper entry of tag and release data into the database and the receipt of incomplete tag or release cards from captains, anglers and mates. Due to the complexity of the new database programs and the lack of data entry training, some of the data was entered incorrectly creating duplicate records or incorrect numbers. Improper entry into the database is difficult to trace and amend from the database. During high volumes of data processing, the number of improper entries can be large. Errors are detected when TBF's staff locates any data that seem "suspicious" (i.e. species listed in locations where they are not found, such as white marlin recorded in the Pacific Ocean).

Another process issue that TBF deals with is improperly filled out cards. About 5 – 10% of the tag and release cards are received as such but fortunately, these can be traced back to the angler by the using the Billfish Tag Issue Report Card (Figure 3). Another difficulty comes with illegible writing that cannot be entered into the database. The inability to read the data from the cards creates a lag time for TBF's staff to complete data processing and send out the certificate reward. During the past three years, TBF receives, on average, over 16,000 tag and release cards a year. Due to the limited resources of TBF, it takes several months for the staff and volunteers to process the billfish data. Other problems related with the tag or release data cards stem from: improper identification of the species, inaccurate weight and length estimates and incomplete location identification. The possibility of inaccurate

estimations and identifications can lead to inaccurate data. This could lead scientists and policy makers awry in their analysis of the data and lead them to derive inaccurate conclusions.

Another concern stems from the design layout changes in the tag and release data cards in the past several years. With the amendments to the data cards, some anglers do not properly fill out cards and leave empty data fields. In addition, a lack of consistency with the tag and release cards also affects the database with new data fields causing confusion for some of the data entry staff. Reasons for the continued revisions to the card involve response to the design changes and testing of a new data collection database and refinement of data queries. New fields to cards include; inquiring about Latitude and Longitude, as well as ocean bodies and hooks used. Since the beginning of March 2006, TBF has amended both tag and release cards twice to try to improve the data collected. Note the changes in the card from Figure 1 to Figure 5.

While the data fields provided by TBF's Tag and Release database are expansive, they exhibit increased focus biological aspects of billfish. The reason can be traced back to the beginning of the Tag and Release Program at which time TBF tried to collect mostly biological data regarding billfish. In early 2000, TBF wanted to strengthen the socioeconomic aspect of the database. While TBF does have aspects of the socio-economics data (measuring boat size and type of hook used), it will ideally record socio-economic data on its constituents. Considering the large number of people participating the program, TBF would have one of the largest bases to measure angler preferences among other socioeconomic data. This would specifically help determine some of the angler's preferences and can highlight billfishermen's level of success during fishing trips. Understanding the preferences of the billfish community is important for policy creation and valuation of billfishing.

The ability to track tag and release records is important to record where the tag cards have gone to and who is using them. Presently, TBF can track the tag cards so they can address any gaps in billfish information, but not with release cards. The tag cards have assigned numbers, which allows researchers and data entry staff to identify specific entries and edit them as needed. Since release cards (Figure 2) lack an identification number, it is extremely difficult to retrieve and edit them. Although the estimated numbers of improperly processed release cards are low, this could cause inaccuracies in billfish data.

TBF is continuously working to standardize data fields to be more accurate and less confusing when people are recording or processing the data. TBF has looked at various types of measurements, such as metric and English standard, fish measurements (Lower jaw fork length, Total length or Measured), and dates (mm/dd/yy or dd/mm/yy). The efforts to standardize the cards have been more difficult to implement than originally thought. Even with

constant reminders made in TBF's publications, specific notices on cards and directly speaking to anglers, many mistakes on data are apparent. These mistakes could arise from anglers' diverse backgrounds that may not be accustomed to using non-metric measurements.

Another issue is the limited resources available to non-profit organizations, such as TBF. TBF's staff does not have the technological expertise or financial means to train their staff to create and expand upon the database of this magnitude. TBF relies on an outside company to develop the database and outside programmers that lack an understanding of the billfish community. With TBF's lack of technical skill and programmers' lack of billfish knowledge, it is difficult to avoid communication problems regarding the database. Often times, neither party understands the other's "language" and vocabulary, causing confusion and delays.

Due to slow turnaround time, it is hard for the staff to recognize the anglers in a timely fashion. Since most anglers value proper recognition, inaccurate numbers and slow distribution of TBF's official Release Certificate are the cause of angler dissatisfaction. This is a concern to the value of TBF's Tag and Release Program because these recognition problems end up negatively effecting TBF's volunteer tag and release constituents. Dissatisfaction leading to decreased angler participation would decrease TBF scientific efficacy.

Problems with TBF's Tag and Release Database

Since 2003, TBF has abundantly distributed release cards globally. TBF is attempting to collect more billfish data, in hopes to enhance the database. The increase in release data has occurred concurrently with a decrease in the tagging data (Figure 6). Since the release cards are free and the tags must be purchased, the release cards may be cannibalizing tagging effort. Filling out release cards gives the user the same recognition as with tag cards: anglers receive a release certificate and entered TBF's Annual Tag and Release Competition. Declines in tagging data collected, undermine the backbone of TBF's Tag and Release Program.

Another problem with the database is the complexity of creating queries and attempting to pull data from them. With the new customizable database, TBF has created more queries but these are complex to construct. In addition, these new queries occasionally interfere with pre-existing queries. This interference can cause some of the numbers from other queries to be inaccurate. For example, some releases records became duplicates and were counted twice. Since TBF staff does not have the technical skill to create or amend such problems, they need to precisely explain to the programming staff what they need to avoid confusion and mistakes. Some issues are not properly addressed simply because of a lack of regular communication between the two parties.

The Future of TBF’s Tag and Release Database

Over the past two years, TBF’s Tag and Release database has been evolving into a user-friendly system by working towards a web-based system, and allowing access to their database to a multitude of different user types including: anglers, scientists, fishing clubs, tournaments, private boats, and charter services. The development of the internet-accessible database will make TBF’s Tag and Release Database more efficient. Once it is ready, outreach and education efforts will be necessary for the billfishing community about how to navigate and use the database.

Originally the tag and release database was based on a DOS computer program that could only be accessed by TBF staff, TBF is working towards allowing the billfishing community access to the database. The objective is for internet-based database to answer any questions the community might have regarding their catch records in order to facilitate continued interest in the program. Moreover, by allowing access to database, TBF hopes to “clean-up” previous problems of entry. This would alleviate pressure on the TBF staff by allowing those who tag and release to enter the data themselves. This in turn would lessen data entry mistakes, force certain fields to be filled out, have a quicker turn around for reward release certificates, and possibly gather more socioeconomic data. When TBF does this, they could have a more effective and accurate database that could be further utilized.

TBF is planning to create three to four different types of access to the database. Each level of access will have various levels of access to records in the database. The first level TBF is an individual angler access level, which would involve only the angler’s data. The angler would be able to enter/edit and view any of their own records at any point in time as long as they had Internet access and correct password information. The angler could also look at certain “general” queries that TBF has provided like amount of tags in 2007 or how many white marlin were recaptured in 2003. While they could access their own records, they would not be able to use their access to view/alter any other angler’s private information in the database. This is to protect other anglers who are competing for any awards and to avoid any data corruption.

The next level would be for fishing clubs and for tournaments. This would allow the directors of the club or the tournament to input/view and edit any data they get for their members and quests and review data from the past years. TBF envisions that whoever is the entering the data for the club/tournament could mark or enter the club name. This level of access would also provide certain queries as well. Not only would the club/tournament have the “general” queries that an individual angler could see, but it would also highlight the previous years catches and location for the tournament or club and they would also be able to add and edit any personal records for any angler and captain. For the protection of other tournaments and

clubs, these people would not be able to look at anyone outside their group. This type of access is helps both TBF and these organizations, it can determine the trend and status of the area fish, determine if one type of gear is more

BILLFISH TAG ISSUE REPORT CARD			
MUST BE COMPLETELY FILLED OUT AT TIME OF PURCHASE			
I HAVE RECEIVED TAGS NO.		BF	BF
NAME (print)			
ADDRESS			
CITY	STATE	COUNTRY	ZIP
PHONE #		FAX #	
PLACE OF PURCHASE	E-MAIL		DATE

Figure 3. Billfish Tag Issue Report Card.



Figure 4. TBF's Release Certificate.

BILLFISH TAGGING REPORT				Please complete applicable items and return card today. Otherwise tagging is of no value. PLEASE PRINT	
TAGGING DATE	LOCALITY	NEAREST CITY / STATE / COUNTRY	TAG #	BF	06680
9/29/06	2545 N 79 52 W				
SPECIES	LENGTH (Est)	CM	WEIGHT (Est)	KL	LB
Swordfish	350		20		
ANGLER	CAPTAIN				
MARK SOSIA	BOWEN		11332		
ADDRESS			ADDRESS		
CITY-STATE-ZIP			CITY-STATE-ZIP		
FISH CONDITION			BAIT TYPE		
Excellent			<input type="checkbox"/> LIVE <input type="checkbox"/> ARTIFICIAL <input checked="" type="checkbox"/> DEAD <input type="checkbox"/> OTHER		
REMARKS				I WANT TO PURCHASE MORE TAGS. PLEASE SEND ME AN ORDER FORM. <input type="checkbox"/>	

Figure 5. An older Tag card used by TBF.

successful than another, and allow for quicker entry and therefore quicker distribution of release certificates and regional awards.

Another level of access is for scientists and students in an effort to promote science on billfish. At this level, the user would have the most access to the data out of the four levels, other than being a TBF administrator and will be able to enter and export data into Excel for research purposes. The only restrictions the user will have is with certain species they can oversee and editing privileges on only their own entered data. Furthermore, they will also be able to email request varying types of queries that TBF can then create to best fit the scientists' research or study. This access benefits both this group and TBF because it will allow a quicker way to pull data, they will be able to create queries that they will be able to look at anywhere with an Internet connection while TBF builds upon its already vast database. This will encourage great research access and achieve TBF's goal of facilitating increase scientific analysis.

All of these different types of access will help TBF become more efficient and accurate in data entry and facilitate research and exchange of information with people all over the world. One of the objectives of the database is to facilitate better communication and data sharing internationally where language barriers can prevent data flow. TBF hopes that more anglers will use the angler website to enter their tag and release data which will allow for quicker entry of the cards, as well as bypass any incorrect addresses or misspellings of names. This database would more importantly make the information in TBF's Tag and Release database more accurate and give a larger sample size for researchers (since there would be less tag and release discards).

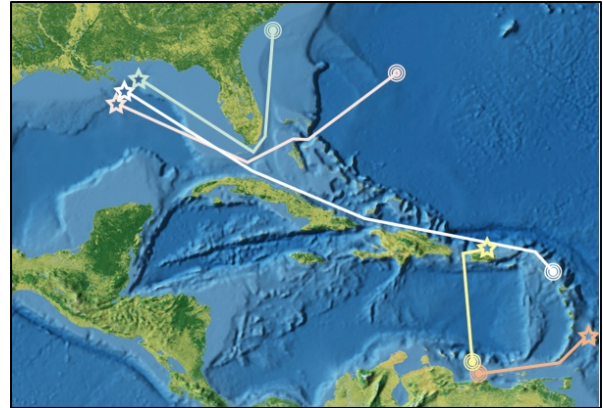


Figure 7. Travels of recaptured Blue Marlin in 2006

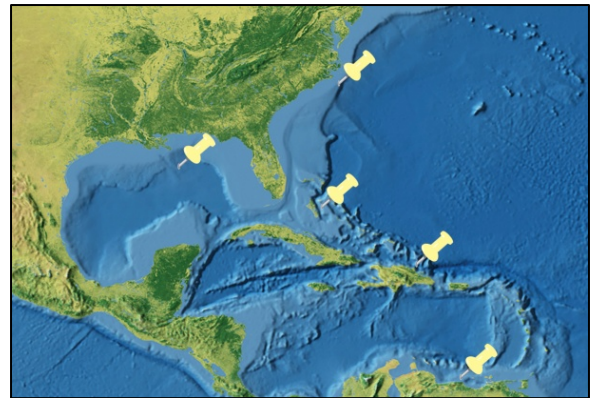


Figure 8. Top location for catching White Marlin

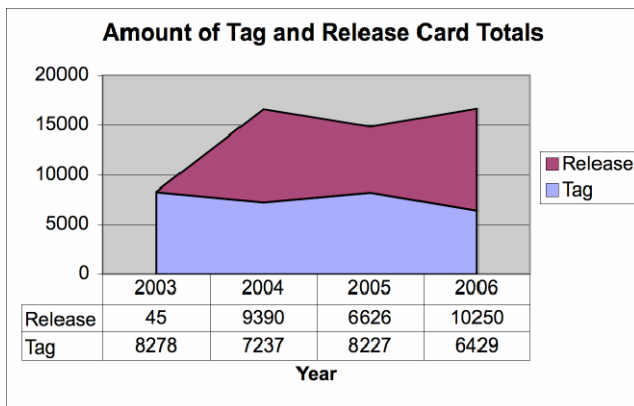


Figure 6. Fluctuation in Tag and Release cards processing.

DISCUSSION

The vision of TBF's Tag and Release Program is to give scientists and policy-makers the necessary data to assist in preserving and conserving billfish stocks without negatively affecting billfishing and the economies of coastal communities. The Tag and Release Program's database is a tool that allows scientists and policy makers to make informed decisions. Although TBF's Tag and Release database is expansive and offers a sizeable amount of data, it can be expanded for greater potential. Since the Tag and Release Program is dynamic and constantly evolving, continual improvements will occur in the future. Below are some improvements (immediate and longer term) to the program to address some of the current issues. If implemented, these recommendations would enhance the quality of billfish data and reinforce the collection processes.

Immediate Recommended Improvements to TBF's Tag and Release Program

The short-term improvements to TBF's Tag and Release database are two-fold; first changes could be made to the processes of data collected and data entry. Second, the program needs to expand the collection of socioeconomic billfish data. Several types of socioeconomic data would be important to have such as reinserting the tournament field, adding a field for unsuccessful catches, and identifying private or charter fishing. Furthermore, TBF needs:

- i) To further educate their constituents on proper entry,
- ii) Reenergize tagging effort,
- iii) Remain consistent data card fields, and
- iv) Redesign the data cards with socioeconomic data fields.

Reintroduction of Tournament Data Field

Since the beginning of TBF's Tag and Release Program, TBF has distributed tags to billfish tournaments to encourage tagging and safe release of billfish. These tournaments are a huge source of revenue for many stakeholders in the region and greatly contribute to the economic well being of the area. The popularity of the billfishing and the lucrative payouts of tournaments have sprouted, just on the Atlantic side of the U.S., hundreds of tournaments for billfish (Table 3). For this reason, tourism bureaus, chambers of commerce, resorts, local shops, and state and local governments often sponsor fishing tournaments.

Table 3. Number and percent of 2005 HMS tournaments awarding points or prizes

Species	Number of tournaments	Percent of tournaments
Blue Marlin	174	67.90%
White Marlin	164	64.10%
Sailfish	162	63.30%
Swordfish	71	27.70%

A Highly Migratory Species regulation tournament is defined as, "any fishing competition involving Atlantic HMS in which participants must register or otherwise enter or in which a prize or award is offered for catching or landing such fish (NMFS 2006)." These tournaments can range from small scale (10 boats) to the large scale (200+ boats) with varying degrees of prizes. NMFS estimated there were over 300 saltwater tournaments in the Atlantic alone in 1999 (USDOC 1990), which has surely increased.

Determining how many billfish are tagged in tournaments is important because fishing tournaments have been historically an important part of measuring billfish and other HMS recreational fisheries since the inception of the tagging program. This type of data can verify how many boats are actually successful in tagging and reveal the

amount of effort necessary to catch a billfish during the tournament.

Understanding how many participants took part in a tournament is important because it can evaluate the social and economic impact of tournament angling in relation to other types of angling (e.g. commercial, non-tournament recreational) and the relative effect of tournament angling on the billfish populations. This data can verify how many boats are actually successful in tagging and reveal the effort necessary to catch a billfish during a tournament. By reinserting the tournament field into the card and having an angler-access database, TBF can help to determine how well economically a certain region is benefiting from the tournament. It can additionally identify what percentages of anglers are coming from out of the area to compete that would help to determine travel costs.

The reestablishment of the tournament data field in the tag cards could also determine economic effects that may have rippled through the local economy and have boosted the local communities from direct expenditures from tournament anglers. Analyzing where anglers are coming from, how many boats have entered and the entry fees in tournaments on a yearly basis can help to do this. A survey of participants of the 1999 Pirates Cove Billfish Tournament determined that nearly 80 percent of tournament anglers were from outside of the tournament's county (Ditton *et al.* 2000). Therefore, these tournaments have shown that they can lead to increased tourism and a total impact exceeding that of the original purchases by anglers (*i.e.*, the multiplier effect) (NMFS 2006). This type of information is extremely valuable to those international and local stakeholders directly and indirectly with the tournaments.

Additional Socioeconomic Data Fields

Currently, TBF does not have a way of tracking "true effort" when anglers go billfishing. TBF's tag and release cards only highlight successful billfish trips, not the "missed opportunities" with billfish. Catching a billfish is not easy to accomplish due to the rarity of fish and the skill required catching one. Since TBF's tag and release card only records successful catches, the use of that data could incorrectly show a high catch effort and would lead to a bias when trying to determine stock assessments. More importantly, since catching billfish on a typical fishing trip is not common, the data collected would be underestimating the value of the fishery by recording fewer trips. Ideally, there should be a way to record successful and unsuccessful trips on the tag and release cards. With the addition of some data fields, (*i.e.* soak time and amount of lines out) TBF will have more data to determine the total amount of fishing effort for a billfishing trips and could determine a more precise measurement of billfish CPUE with a larger sample size.

Another important socioeconomic data field that would benefit TBF would be recording whether a private

or a charter service was used to go billfishing. Understanding whether or not that the angler went out themselves or with a charter service is important because it can determine how many anglers are dependent on using charter services, how many private/charter boats are billfishing in one area, and which charter service is the most popular. All of these fields can demonstrate how important recreational fishing could be in a region both economically and socially which could help to steer policies.

An added benefit of having the distinction of charter versus private would be a more equitable awarding within TBF's Annual Tag and Release Competition. Private captains would have an equal chance to win an award as a charter captain would, who has more opportunities to catch billfish. Considering how many people enjoy recognition in the angling community, by giving an equal opportunity for everyone, this could be another member or donation avenue for TBF as well.

A number of edits to the tag and release data fields could strengthen the data collection process. Specifically, TBF should follow a clear routine to record and process the data. Since changes in data fields could affect the amount of data recorded, TBF needs to ensure consistency in the tag and release card for a couple years before making any changes or they should publicize that the cards have been revised.

If revised cards are planned, TBF must make sure the cards are not cluttered. Cluttered cards would be confusing to the angler and therefore less likely to be filled out. A redesigned card should have ample spacing of the data fields that allows enough space to record data. When designing new cards there should be careful consideration for the biological and socioeconomic information, as well as, the recognition of the angler, captain, and mate participation. With this in mind, members of each party involved with the card should be asked to participate in the next redesign to maximize card completion and priority data capture.

Methods and Process Recommendations

Aside from the socioeconomic data recommendations, some methods and process changes could be made to ensure data quality and database efficiencies. Educating the billfishing public on properly recording billfish data is key. Considering the percentage of incomplete and improperly filled out cards (5 – 10%) it would benefit TBF's data program to increase its efforts to educate anglers about the proper way to fill out tag and release cards. New avenues of distribution or incentives could be looked into to further increase data collection accuracy.

TBF should place proper data entry instructions and frequently seen data problems in more prevalent to the public. TBF could send out regular reminders in TBF's biweekly e-news letter and by highlighting the importance in their webpage. Additionally, when the angler-access becomes available, TBF will need to further educate the

billfishing population on how to utilize the on-line entry with possible workshops. With continuous education for those entering the information, the data will become more accurate and valuable.

TBF should reinvigorate and publicize the importance of tagging and diminish the release portion. TBF, as well as other organizations rely on the tagging data. If there was declining tagging effort, answering many questions regarding billfish would be more difficult. Without tagged billfish data, there would be no way to determine billfish movements and growth rates because there would be no prior history on the fish. TBF could curb the distribution of the release cards and offer greater recognition to anglers who tag while lessening those who just release. TBF could also give higher incentives to tag, by offering rewards if an angler tags a certain amount of fish like a free TBF hat, jacket, or free tags.

To expedite the procedure of the data processing, TBF should investigate expanding its volunteer/intern network. They should promote and publicize their work to science classes at schools and other organizations. These groups are typically interested in assisting because it will give them work experience and practical knowledge. For example, a science teacher could use the data in a lesson plan to look at simple trend analysis for billfish. Additionally, TBF could give incentives to these organizations such as recognition in publications, trips to symposiums, school credit and travel.

Similarly, TBF could create a manual for data-entry and make the text in the internet-based database clearer. A data-processing manual could provide answers to many of the common questions of data entry and clearly delineate how to avoid data entry mistakes. The language in the manual and database must be clear, just in case the volunteer staff is unfamiliar with billfish terminology. Since the database is complex in nature for those not accustomed to it, errors can occur in data processing. If the field text in the database were geared towards non-anglers, it could reduce the number of mistakes. All of these steps would increase the efficiency of the data processing.

Over the past two years, TBF has been working on a new web-based database that gives them the ability to create queries to interpret more data. This new database allows TBF, with the help of a programming team, to create a variety of queries. While these queries have provided new information to TBF, it has also made working with the database more complex and labor intensive. This necessitates a lot of communication between TBF and their computer programming team to get the data correctly interpreted. TBF and the computer programming team should hold regular progress meetings to coordinate effectively on project goals. Having regular and educational dialogue between the parties can help to alleviate any "billfishing language" barriers and technical complexity issues. Moreover, it will facilitate a reduction in TBF requests to the computer programming staff, as

TBF staff will have the capacity to understand the difficulty level of project requests.

Blueprint for an Ideal Database

While the recommendations above assist TBF in improving its Tag and Release Program, the following long-term recommendations would provide additional help to the data program. The improvements provided would also allow TBF's database to be a model for other fishing constituent tagging databases. Moreover, it would provide countless amounts of biological and socioeconomic data that would fill in many of the gaps in billfish knowledge to the public.

When developing new data fields, one of TBF's concerns is whether the angler will record the necessary data. TBF is interested in expanding its socioeconomic data, but is concerned that as some of the questions could appear to be intrusive. In order to maintain support for its conservation efforts and volunteer programs it has to be careful as to not offending any participants. Data such as ethnic background or personal wealth are important indicators of a potential policy's feasibility. The anglers' life history and background are some of the valuable personal information TBF could collect. The data fields would include questions on family background, household income, ethnicity, and education levels. These types of information would provide a greater understanding of constituents and would allow TBF and policy makers to see who would be affected and help steer certain policies affecting billfish and their stakeholders. It would also help to confirm or refute any information of previous angler studies. To ease any concerns and to possibly get a higher response from their constituents, anonymity could be given for sensitive personal information. Furthermore, assurances could be given that none of the information gathered would be sold to a third party. More importantly, educating constituents on the importance of this information and how it can be used for policy makers would help ease concerns. For example, it could show the level of interest a region has in a policy and illustrate how strong financially or politically this group could be.

If it was not a concern of overwhelming anglers with data collection requests and size restraints of the tag and release cards, specific types of socioeconomic data fields could be added. For example, specific gear data could be collected when anglers go billfishing to determine things like if a 30 pound test can catch a 500+ pound blue marlin. This could be important data because the lighter the test the longer an angler must "fight" the fish, sometimes leaving it susceptible to shark predation. Considering the billfishing community is conservation minded, data collected from specific gear used could lead to a gear regulation that could protect more billfish from predation. Information based on data like this would be extremely accurate tool for policy makers as well as the angling community.

With the large amount of release cards received by

TBF annually, there should be a method to identify and then edit them. If they are not able to be located, it is difficult to edit mistakes and corresponding analyses. To deal with tracking problems release cards could be given a number like the tag cards so that they can be tracked for edited or verification. Additionally, when the web-based access is available, the data entry staff could enter tag number series directly into the database instead of filing (yellow cards) them. All of these recommendations would make the data entry more time efficient rather than staff attempting to locate them and processing them.

The tag and release cards have an impressive amount of geographical information that could serve as another powerful tool for the Tag and Release Program. TBF could use the GPS coordinates from the cards and illustrate them with a geographical information systems (GIS) map on the Internet. By visually illustrating things on the database, TBF and its constituents could see many things like: where anglers are coming from, where they are catching their fish, and can illustrate simple migration and movement analysis.

All of these recommendations would help to improve the efficiency, the accuracy and the significance of TBF's Tag and Release Program. With a higher amount of socioeconomic data, decision-makers and the public will have the necessary information to understand the billfishing industry and the economics of shoreline communities. Additionally, with efficient data processing, more time will be available to TBF's staff to concentrate on other projects like data analysis and publications.

CONCLUSION

Organizations, like The Billfish Foundation, were established from concerns of what anglers are seeing on the water. Their programs were created to empower the billfishing community with enough information to advocate effectively for policies that protect billfish and billfishing. Despite billfish's popularity and high-profile stature, little is known about these enigmatic and mysterious creatures. The rarity of billfish and their expense to find them plays a negative role by presenting little data for scientists and lawmakers. TBF's Tag and Release Program is an important avenue that the recreational billfishing community has embraced to answer more questions surrounding billfish. This assessment of TBF's Tag and Release Program is the first step to improve the program and making the database stronger and more accurate. TBF envisions a comprehensive and cohesive database that encompasses both biological and socioeconomic data from its constituents and for decision-makers. TBF has worked hard to create a tool for scientists and decision-makers in order to empower the billfish community. TBF can continue to build on this by: collecting more socioeconomic data, looking for new avenues for billfish tag distribution, creating and interpreting new queries for new and better billfish analysis, and educating the public lead

billfish community in advocating for successful policies. With TBF's continued endeavor to improve its Tag and Release Program, its database system will be a powerful instrument for the protection of billfish and their communities, as well as becoming a model for other tagging programs.

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