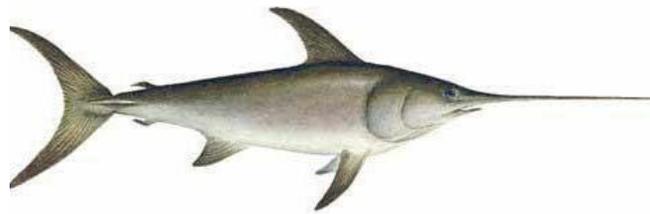
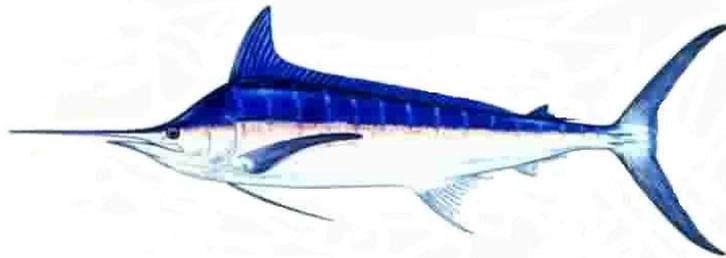




A Summary of Blue Marlin Conventional Tag Recapture Data from NMFS-SWFSC Cooperative Billfish Tagging Program in the Pacific Ocean

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Executive Summary

The ISC Billfish Group has identified tagging data as potentially useful to examine stock structure hypotheses and provide information on movements in support of stock-assessments. The NMFS Cooperative Billfish Tagging Program in the Pacific has been in operation since the 1960's but there is still limited information on the stock structure of highly migratory billfish, and movement data from tagging programs generally have not been included in stock assessments. The tagging data presented here show movements across the Pacific, including movement from the Northern Hemisphere to the Southern Hemisphere. However, the majority of recaptures occurred proximal to their initial tagging location.

Introduction

Tagging data have been identified as potentially useful for the assessment of Pacific blue marlin (Kleiber et al. 2003). In general, tagging data can inform spatially explicit aspects of assessment models (e.g. advection-diffusion, population structure), provide basic biological information (e.g. growth rates), contribute to estimating fishery specific parameters (e.g. fishing mortality), and corroborate other information (e.g. spatial structure inferred from genetics or CPUE trends, etc.). This paper summarizes blue marlin tag-recapture information from the NMFS-SWFSC Cooperative Billfish Tagging Program for the Pacific Ocean, which is maintained by the Southwest Fisheries Science Center.

Data and summaries

The database contains 11684 records of tagged blue marlin and 94 records of recaptured blue marlin. However, only 71 of those recaptures were also identified as blue marlin upon tagging (23 were identified as other species such as striped marlin). Therefore, recapture rate is calculated as 0.608% (71/11684). Of the 71 confirmed recaptures, 6 were missing either tagging location or recapture location, and 2 more were missing either tagging or recapture dates. This left a total of 63 records in which species ID was consistent and all tag and recapture date and location data were available, and these records are used to calculate and plot displacement summaries and statistics.

Blue marlin tagged in the Eastern Pacific (Figure 1, EPO = east of 130 West, shown as 230 longitude on map) were recaptured as far away as Hawaii and French Polynesia (south of the equator), but most were recaptured near their tagging location. Blue marlin tagged in the Central Pacific (CPO = west of 130 West, shown as 230 longitude) were recaptured in all parts of the Pacific, including as far away as Taiwan, southern Baja California, New Caledonia and south of French Polynesia. While CPO marlin tended to be recaptured further away than EPO fish, most were recaptured near their CPO tagging locations (Figures 1 & 2). Across all marlin, time at liberty ranged from 1 to 1503 days (mean \pm s.d. = 301.2 ± 365.3), with a minimum straight-line distance traveled ranging from 0 to 8240.7 km (997.6 ± 1863.1 km), and speed ranging from 0-44.5 km/day (mean \pm s.d. = 8.3 ± 11.3 km/day) (Figure 3).

Size at initial tagging was either absent, or highly unreliable because billfish are generally tagged and released while the animal remains in the water. However, size at recapture measurements are often taken, and sizes of a total of 54 fish weighed (in lbs, whole weight) at recapture were examined (Figure 4). There were only 18 length measurements taken at recapture of known type available (eye-to-fork, lower jaw-to-fork), and most were not paired with weight measurements.

Discussion

The tagging data presented here show movements through most of the tropical Pacific including across the equator. A summary of global billfish tag-recapture information published by Ortiz (2003) indicated a recovery rate from the NMFS-SWFSC Cooperative Billfish Tagging Program (as of 2002 approximately) of 0.87 (46/5303). That summary also included data from the The Billfish Foundation, Australia and New Zealand programs in the Pacific. Although the information in this summary appear to represent similar patterns to Ortiz (2003), a few recaptures from the marlin tagged in the Western Pacific and eastern tropical Pacific visible in that paper do not appear here. These data are informative about spatial range and structure of the stock as well as regional patterns of dispersal, but are of insufficient quality to be used for growth rates.

Because billfish tagging occurs most frequently from the recreational rod and reel fishery, the circumstances on the boat during initial capture and tagging are often sub-optimal for reliable data collection. Billfish are usually tagged while they remain in the water, and the chaotic atmosphere on recreational boats during the capture process probably do not lend to reporting reliable data consistently, thus species ID, size estimates and fishing coordinates should be considered cautiously. Since 24.5% (23/94) of recaptures were identified as a different species upon tagging, this information might be taken into consideration for 'correcting' the number of blue marlin tagged if an assumption is made about species misidentification at tagging. Recapture records are probably less prone to mistakes because the animal usually needs to be killed and brought on deck to recover the tag (and perhaps measure the animal). As such, species ID is probably more certain, although some degree of error in recording recapture position and date is likely as well.

References

- Kleiber P, Hinton MG, Uozumi Y (2003) Stock assessment of blue marlin (*Makaira nigricans*) in the Pacific using MULTIFAN-CL. *Marine and Freshwater Research* 54:349–360
- Ortiz M, Prince ED, Serafy JE, Holts DB, Davy KB, Pepperell JG, Lowry MB, Holdsworth JC (2003) Global overview of the major constituent-based billfish tagging programs and their results since 1954. *Marine and Freshwater Research* 54:489–508

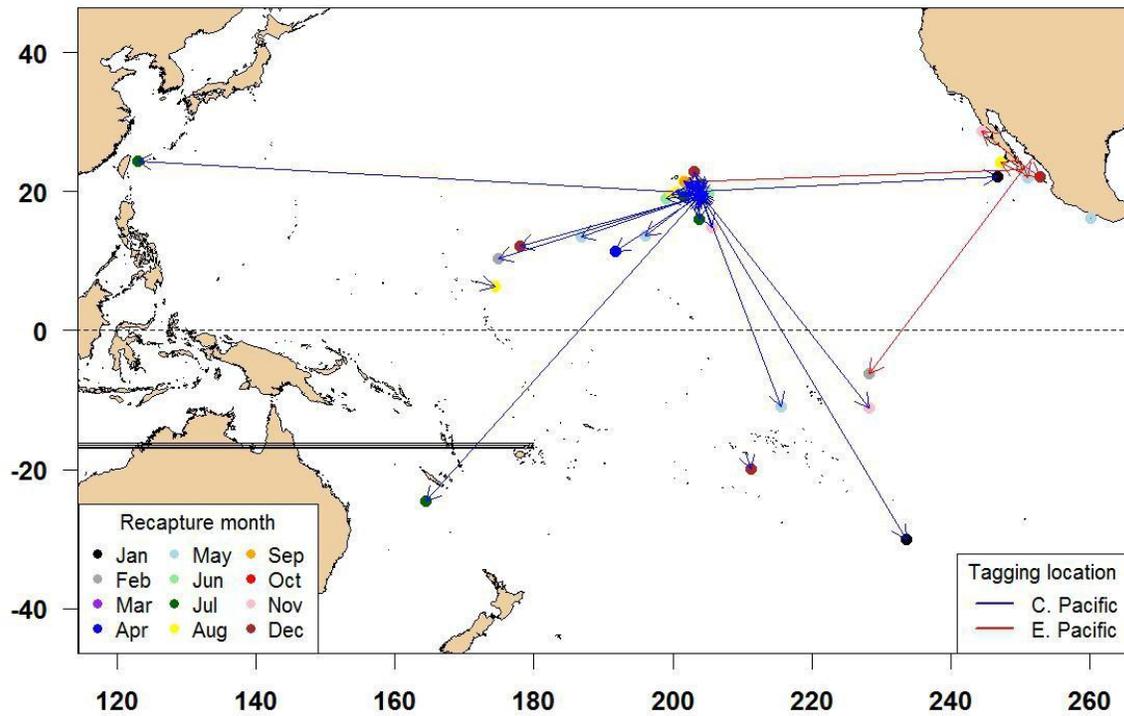
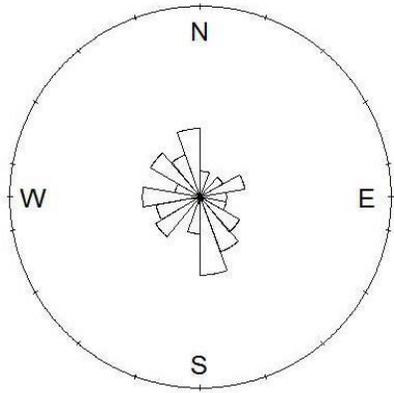


Figure 1. Conventional tag recaptures of Pacific blue marlin from the NMFS gamefish tagging program. Arrows are colored by region of initial capture (see legend at bottom right), with month of recapture depicted by colored circles at each recapture location (see legend at bottom left). The solid lines crossing northern Australia to Fiji in the southwest Pacific are anomalies of the mapping software and should be ignored.

Tagged in Central Pacific



Tagged in Eastern Pacific

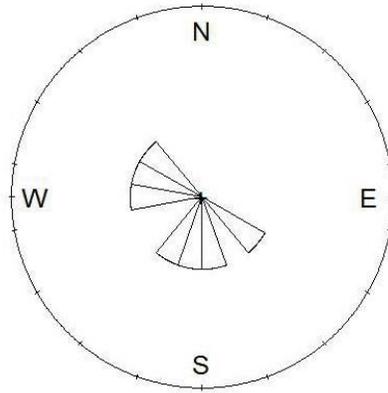


Figure 2. Circular histograms of blue marlin direction traveled between tagging and recapture locations. Directions are divided into 18 histograms (20 degrees per bin). The length of each bin is proportional to sample size (longer bins have more data than smaller bins).

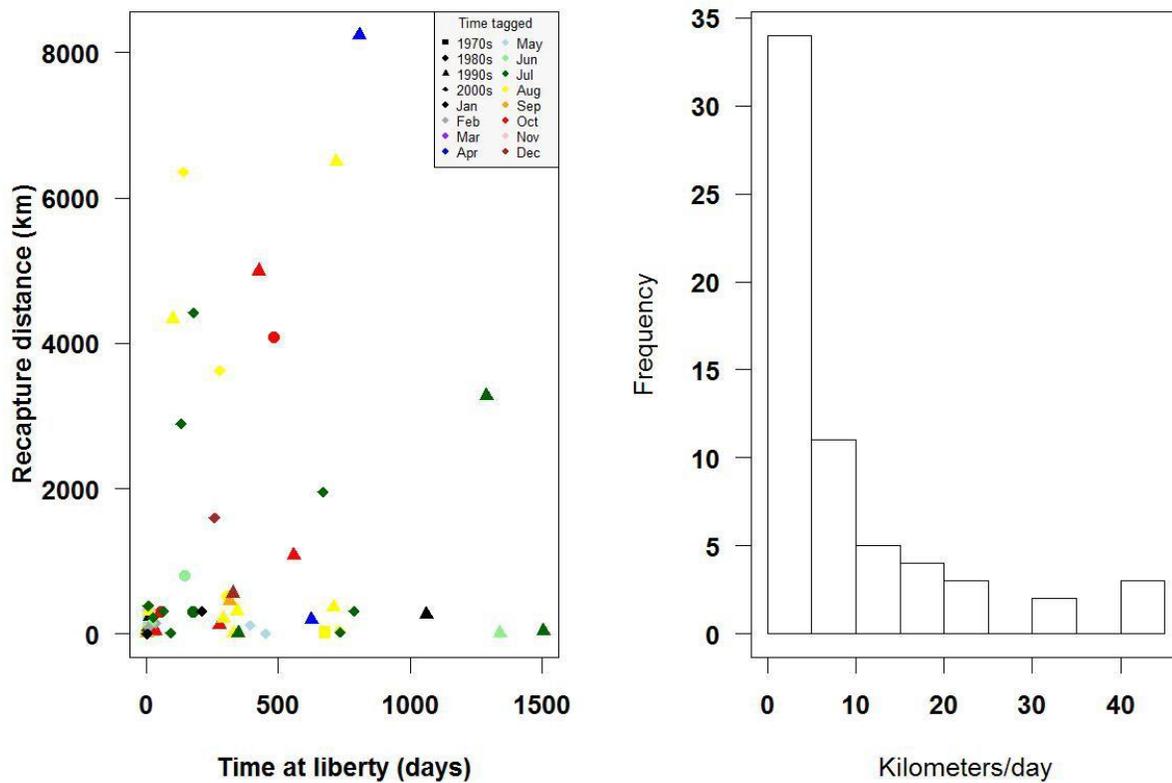


Figure 3. Left panel: Great circle distance (km) of recaptured blue marlin by time at liberty (days). Symbols depict the decade of initial animal capture & tagging, and colors depict the month of initial animal capture & tagging (see legend). For example, a red triangle means it was captured & tagged in October during 1990's. Right panel: Histogram of great circle distance traveled per day at liberty.

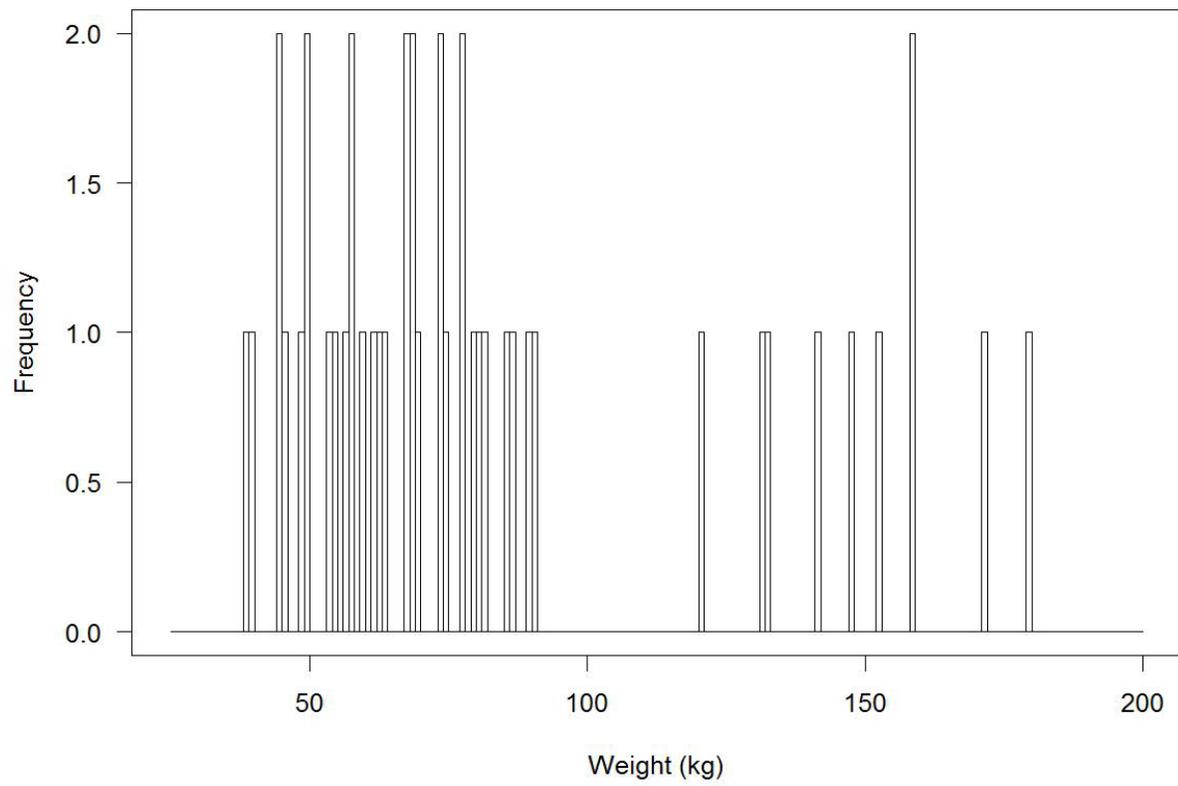


Figure 4. Histogram of blue marlin whole weights at recapture (n=54) from tag-recapture database. Weights are converted from lbs to kg (1lb = 0.4536 kg).