

SOUTHWEST FISHERIES CENTER

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HONOLULU LABORATORY

NATIONAL MARINE FISHERIES SERVICE

FISHERY STATISTICS OF THE WESTERN PACIFIC, VOLUME III

Territory of American Samoa (1985-86)
**Commonwealth of the
Northern Mariana Islands (1985-86)**
Territory of Guam (1985-86)
State of Hawaii (1985-86)

COMPILED BY

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GUAM FISHERY STATISTICS, 1985 AND 1986

INTRODUCTION

The Territory of Guam (lat. 13.4°N and long. 144.4°E) is the southernmost, largest, and most populous island in the Mariana Archipelago. All of the islands in the chain north of Guam belong to the Commonwealth of the Northern Mariana Islands. Guam is located about 6,000 km (3,700 mi) west-southwest of Honolulu, 2,500 km (1,550 mi) south-southeast of Tokyo, and 2,600 km (1,600 mi) east of Manila. Guam is about 48 km (30 mi) long, varies from 6 to 14 km (4 to 9 mi) wide, and has an estimated land area of 554 km² (214 mi²) and a population of about 120,000.

Fishing activities on Guam can be divided into two basic categories: offshore and inshore fishing. Offshore fishing typically involves small boat (12 to 48 feet), 1 to 2-day trolling and bottom fishing trips that usually originate from one of the three principal harbors located on the west coast and southern tip of the island. Inshore fishing is typically conducted without the use of a boat and consists mostly of nearshore casting, netting, and spearfishing. The Guam Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) has been conducting offshore and inshore creel surveys since the early 1970's. Beginning in 1982, DAWR began modifying its data collecting and processing systems to improve estimates of catch and effort by improving sampling techniques and by incorporating the use of microcomputers to expand the survey data. The WPACFIN provided microcomputers and training and worked with DAWR staff and a contractor to redesign the sampling program. In 1982, WPACFIN also began working with local fish wholesalers to obtain information on the commercial landings of Guam. It is from these two sources, DAWR and wholesalers, that the original data for the statistics presented in this report have come.

DATA COLLECTING SYSTEMS

The Guam data collecting systems are divided into two distinctly different systems, one for collecting commercial landings information and one for collecting total landings information through creel surveys.

Commercial Landings

Fish entering the commercial market in Guam come from three sources, full-time commercial fishermen, part-time commercial fishermen, and subsistence or recreational fishermen who frequently sell portions of their catch. No licenses are required to sell fish in Guam, nor are there any reporting

IV.2

requirements for those selling fish. Before 1979, there was no central place to sell fish, so fishermen had to develop their own markets and peddle their own fish after each trip. The Guam Fishermen's Coop was established, via some government funding, in Agana in July 1979. The Coop subsequently became the central distribution center for fresh local fish. In 1982, WPACFIN began working with the Coop to improve their invoicing system and obtain data on all fish purchases. A cooperative system was established whereby the Coop would use the forms and coding schemes designed by WPACFIN and would supply copies of all invoices to WPACFIN for entering into computer format. In return, WPACFIN would provide the Coop with document quality control and computer generated summary statistics to help the Coop improve its business. All purchase data back to July 1979 also were coded and computerized.

Two other fish wholesalers began operating in Guam in late 1983, and WPACFIN established similar data collecting and processing arrangements with them. Although these two fish wholesalers eventually left the business, one in 1984 and one in early 1987, it is through the voluntary cooperation of all three wholesalers that reporting on the commercial fisheries of Guam is possible. All tables and figures of commercial landings information included in this report are provided with the consent of these wholesalers. The majority of fresh fish entering the commercial market in Guam during 1985-86 were purchased by one of the main wholesalers, although a few fishermen still peddled their catches themselves.

Data collected on commercial forms include

- Date
- Fisherman code
- Number of fishermen
- Hours fished
- Area fished
- Species caught
- Number of pieces caught
- Pounds caught
- Price per pound

Creel Surveys

The DAWR has the responsibility to monitor and protect the wildlife and marine resources of Guam. To this end, it began conducting creel surveys in the early 1970's. By systematic, random interviewing of fishermen, DAWR developed a means of estimating total catch and effort by fishing method for the inshore and offshore fisheries. Sampling methodologies were frequently modified in the early years to incorporate new information and insights gained during the surveys. Aerial surveys were conducted for several years to help improve estimates of percent coverage. The basic survey methodology was

IV.3

fairly well established by 1979. All data processing was done by hand.

In the 1970's, an annual fishing derby was organized on Guam by groups of local fishermen. This 3-day tournament soon became a highly successful event, with much participation by local recreational and commercial fishermen. The DAWR began collecting census information on the Annual Mariana's Fishing Derby activities as a means of obtaining additional catch and effort information. Although the significance of these data is minor compared to the creel surveys, summaries of derby results are included in this document as a point of interest.

In 1982, WPACFIN hired a contractor to work with DAWR staff to improve the statistical validity of the creel surveys and to establish mathematical algorithms to expand the sample data to estimate total catch and effort with confidence intervals. Consequently, DAWR further improved its sampling methodologies based on the contractor's recommendations, such as adding surveys to better estimate total participation. The WPACFIN developed computer processing systems to automate the data handling and expansion activities. The system design is flexible enough to allow for continued improvements as additional information, insight, and funding are gained. It is essential for the user to understand the basic sampling design and some of the assumptions made for the offshore and inshore surveys to facilitate proper interpretation of the resultant statistics.

The DAWR's fishermen interviews, also called creel surveys, are divided into two separate, major surveys, offshore and inshore. Both are based on a systematic, random sampling of the fisheries; field sampling and interviews are done on a specific number of randomly selected weekdays and weekend-holidays each month. Both surveys are stratified by weekday and weekend-holiday sampling and, during 1985-86, were conducted on 4-6 days per month. Both include two subsurveys, one for counting and estimating total participation and one for actually interviewing fishermen for catch and effort information. Both are based on the assumptions that the information given by the fishermen is accurate and the fishermen interviewed are representative of the entire fishing population.

Offshore Creel Survey

Most offshore fishing trips originate from one of three harbors on Guam. Apra Harbor is the largest of these harbors, serves military and commercial shipping activities, and is considered one of the best natural harbors in the western Pacific. It ranks third among the harbors as points of origination for offshore fishing trips. Cocos Lagoon on Guam's southern tip is the second largest protected harbor and ranks second as a launching area for offshore fishing trips. The

IV.4

Agana Boat Basin, centrally located on the west coast of Guam in the capitol of Agana, is the smallest of the three harbors but is the busiest launching area for offshore fishing trips. Therefore, DAWR selected the boat basin as the site for interviewing offshore fishermen.

Concurrent with interviewing fishermen returning from trips at the boat basin, a participation survey is conducted to obtain counts of boating activity for the entire island. For estimating total participation for a survey day, unless contrary information is available, a boat is assumed to be fishing if it is "out," as evidenced by its trailer at a boat ramp or being missing from its normal berthing area. A further assumption is made that the fishing activity and success rate of fishermen originating at the Agana Boat Basin are not statistically different from those of fishermen leaving from other areas on the island. The basic premise of the offshore sampling program is that the combined interviews collected on each survey day are sufficient to estimate the average catch and effort for each fishing method used during that day. Therefore, each survey day represents a measurement of the offshore fisheries. Data collected during the participation portion of the offshore creel survey are limited to boat count by launching area, whereas data collected during interviews include the following:

- * Date (year, month, day)
- * Type day (weekday or weekend-holiday)
- * Fishing method
- * Interview time
 - Area fished
 - Boat number
- * Number of fishermen
- * Number of gear units
- * Hours fished per gear
 - Total count for all species combined
 - Type total count
- * Total weight for all species combined
 - Type total weight
 - Total number of species
 - Type total number of species
- # Total count for each species
 - Type count for each species
- # Total weight for each species
 - Type total weight for each species
- # Species name (or species group)
 - Length for an individual fish
 - Type individual length
 - Weight for an individual fish
 - Type individual weight
 - Bait used (up to three different types)
 - Wind direction and speed
 - Weather conditions
 - Cloud cover

IV.5

Lunar day
Percent of catch kept
Percent of catch sold to the Coop
Percent of catch sold elsewhere

It is not always possible for the interviewer to obtain information on all items listed. However, those marked with an asterisk (*) are essential to the data expansion process for estimating total catch and effort. Those marked with a pound or number sign (#) are essential to estimating the percent species composition of the catch. The "type" elements (e.g., type individual length) identify the kind of measurements, i.e., either actual, estimated, or calculated.

Inshore Creel Survey

Fielding the inshore creel survey is considerably more complex and troublesome than the offshore survey for several reasons. For instance, fishing activities originate from and occur over a large portion of the coastline, making participation counts and fishermen interviews much more difficult to obtain. Additionally, it is more difficult to obtain interviews for completed fishing trips because the interviewer must survey many miles of coastline where fishermen may quickly terminate their activities at any time. The turnover rate of fishermen during the sampling period is a difficult factor for which to adjust. Tidal stage and moon phase also influence inshore fishing much more than offshore fishing. Nighttime and seasonal pulse fishing are also major considerations for the inshore fisheries. In October 1984, DAWR began additional survey efforts to help quantify the nighttime and seasonal inshore fisheries.

Notwithstanding these complexities and problems, the basic designs of the offshore and inshore surveys are very similar in that they both have participation counts and creel interviews. Two of the significant differences between the offshore and inshore surveys are that the inshore participation counts are made by fishing method as well as by location, and that interview information is combined to form averages of catch and effort for a much larger time period (month, quarter, year) than a single day as in the offshore survey. Therefore, daily measurements of the inshore fisheries are based on island-wide participation counts for a survey day by using averages for the catch information based on user-specified, flexible time periods, typically quarterly and annual averages. This modification of the expansion algorithm was required for DAWR to physically complete an inshore survey with limited manpower. Participation counts for essentially the entire island can be obtained during a single sample day, but adequate creel interviews for all methods for the entire island cannot be obtained with the manpower available. Additionally, the surveyable portions of the coastline are divided into three

IV.6

regions to facilitate statistically sound sampling of fishermen. Data for the day and night surveys are processed and expanded separately. Data on the seasonal fisheries for juvenile rabbitfish and bigeye scad are collected at irregular intervals when the fisheries are active. Information collected during the inshore participation surveys includes

- * Date (year, month, day)
- * Type day (weekday or weekend-holiday)
- * Location fished
 - Time sighted
- * Method used
- * Number of persons
- * Number of gear units
 - Reef zone fished
 - Weather and water conditions
 - Tidal stage

Information collected during the inshore interviews includes

- * Date (year, month, day)
- * Type day (weekday or weekend-holiday)
- * Fishing method
- * Interview time
- * Location
 - Reef zone fished
- * Number of fishermen
- * Number of gear units
- * Actual hours fished per gear
- * Estimated trip time
 - Total count for all species combined
 - Type total count
- * Total weight for all species combined
 - Type total weight
 - Total number of species
- # Total count for each species
 - Type count for each species
- # Total weight for each species
 - Type total weight for each species
- # Species name (or species group)
 - Length for an individual fish
 - Type individual length
 - Weight for an individual fish
 - Type individual weight
 - Bait
 - Wind direction
 - Wind speed
 - Weather conditions
 - Cloud cover
 - Surf
 - Tidal stage
 - Swell direction

IV.7

As in the offshore survey, the interviewer cannot always obtain information on all items listed. Those marked with an asterisk are essential to the data expansion process for estimating total catch and effort. Those marked with a pound or number sign are essential to estimating the percent species composition of the catch. The "type" elements (e.g., type individual length) identify the kind of measurements, i.e., either actual, estimated, or calculated.

DATA PROCESSING SYSTEMS

The Guam data processing systems are divided into two separate and distinctly different systems, one for processing the commercial landings data and one for processing the DAWR creel survey data.

Commercial Landings

The processing system for the commercial landings data collected from the wholesalers is fairly straightforward. A purchase form is completed by the wholesaler each time fish are purchased from a fisherman. Catches are divided into categories for weighing by species or species group, and where practicable, number of pieces is recorded. Preferably, coding and initial quality control of the forms are done by Coop or DAWR personnel before they are shipped to WPACFIN for computer processing; however, these activities must sometimes be done by WPACFIN staff. Data are entered into a computer and loaded into central WPACFIN data bases, where edit reports are generated and used to locate and correct any errors in the data base. Once all edits, verifications, and corrections are made, summary reports are generated. Standard reports available include total monthly and annual landings by species, total landings by fisherman, and landings by fisherman by species. Purchase forms are returned to the wholesalers along with summary reports and graphs for their use.

Creel Surveys

The processing systems for the creel surveys are much more complex than those for the commercial landings data. The basic data handling and processing systems for the inshore and offshore surveys are the same. Data forms completed in the field during the participation and creel surveys are returned to the office and edited for completeness and legibility before the data are entered into structured computer data bases by using commercially available data base management software. Edit and summary reports are produced to verify the quality of the data, and any errors are corrected in the data bases. Data bases are then translated into standard record formats, which are readable by the data processing and expansion systems programmed by WPACFIN specifically for the offshore and inshore surveys. As

data are converted into the Guam Offshore Expansion System (GOES) and the Guam Inshore Expansion System (GIES), additional error checks are performed by the computer to ensure only valid information enters the expansion systems. Errors are flagged and printed to facilitate correction. The GOES and GIES are user-friendly, menu-driven systems that step the user through a series of processes that summarize creel survey and participation data to produce catch and effort expansion and species composition files and reports. Although the GOES and GIES allow processing data for whatever time increment the user specifies, typically 1 month of data is processed at a time for the offshore surveys, and 3-month or annual data are combined for the inshore surveys.

Generally speaking, the expansion algorithms for the offshore and inshore surveys are very similar. Estimates of total catch, effort, and participation for each fishing method are generated from information collected during the participation and creel surveys. The GOES uses same-day catch and effort averages to expand the participation counts, whereas the GIES uses user-specified, time period catch and effort averages to expand the daily participation counts. Inshore day and night surveys are treated identically but separately. The daily estimates are considered measurements of the fisheries for that day. Average weekday and weekend-holiday estimates and their associated variances or confidence intervals are created from individual daily measurements. These are weighted by the number of each type of day in the month, or other timespan, and multiplied by proportionality constants to adjust for percent coverage to produce estimates of total catch, effort, and participation along with their confidence intervals. All steps in the expansion process are stratified by fishing method. The expansion systems produce several detailed summary reports and a summary expansion data file containing the final totals for all important catch and effort statistics. This summary expansion file is later used to produce the types of reports contained in this document.

Estimates of species composition of the expanded catch are obtained for each method by multiplying the calculated percent species composition of the surveyed catch by the expanded total catch. Percent species composition by fishing method is obtained from the sampled catch based on the average individual weight and the total number of individuals recorded for that species. The average size of each species is obtained by one of three methods, depending on the availability of data in the data base. If total weight and count information are available, the average size per individual is calculated by dividing the total weight by the total count. If total weight and count information are not available but individual weight measurements for a species are available, the average size per individual is calculated by dividing the sum of all individual weights by the total number of individuals weighed. If neither of these

IV.9

methods can be used because no size information is available in the data base, the user is asked to input the species' average size, which is then multiplied by its total count to estimate total sampled catch of that species. Therefore, percent species composition is calculated by dividing the estimated sampled weight of the species by the estimated total sampled weight of all species combined. The species composition programs produce summary reports for immediate reference and summary data files for later use by reporting and summarizing software for generating the types of reports contained in this document.

Catch, effort, and participation data collected during the seasonal fisheries for bigeye scad and juvenile rabbitfish are processed by hand. Interview records are scarce, so hand tabulations and expansions are made to produce ballpark estimates of catch.

DATA REPORTING SYSTEMS

The Guam data reporting systems are divided into two separate systems, one for reporting on the commercial landings data and one for reporting the results of the creel survey.

Commercial Landings

After completing all editing and quality control activities for the commercial landings data, monthly and annual summary reports by species are generated. The commercial landings reports section of this document includes monthly and annual reports for 1985 and 1986. Volume II of this report series contained these reports for July 1979 through December 1984. Each report contains information on the pounds, value, average price per pound, and number of recorded landings for each species or species group. The number of recorded landings ("RECORDS" in the tables) is a measurement of how many times each species was purchased, regardless of its number or weight in the landing. This statistic is provided to give an indication of the frequency each species is reported. The POUNDS can be divided by the RECORDS to calculate the average weight of each landing. Each monthly report contains a subtotal for the sum of all species combined for that month, and the December report also includes the annual total. Annual reports contain the total landings for each species and the total recorded landings for all species for the calendar year.

Included with the commercial landings summary reports are graphs of some of the important statistics. The following groupings of species, species categories, and abbreviations are used in the tables and graphs for Guam's commercial landings: