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PLANNING DOCUMENT FOR THE ASSESSMENT OF MARINE RESOURCES AROUND GUAM AND THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

by

Jeffrey J. Polovina
Southwest Fisheries Center, Honolulu Laboratory
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96812

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INTRODUCTION

Guam and the Commonwealth of the Northern Mariana Islands (CNMI) consist of a chain of 25 volcanic islands arranged in an approximately north-south axis 450 nmi long (Figure 1). The total land area of these islands is 370 nmi^2. To the west of these islands and within the U.S. Fishery Conservation Zone (FCZ), there are numerous seamounts. To the southeast of the chain is the Mariana Trench where a depth of almost 6,000 fathoms has been recorded.

The waters around Guam and CNMI are rich in marine resources and historically some of these resources have been commercially fished. There is, however, a need for a comprehensive assessment of the abundance and commercial potential for the marine resources in this region to aid local governments to develop local fisheries, to serve as baseline information for mainland U.S. interests in determining whether to invest in fishery projects in the area, and to provide data to the Western Pacific Regional Fishery Management Council (WPRFMC) in their development of management plans as mandated by the Magnuson Fishery Conservation and Management Act (MFCMA).

The geographic area covered by the program is the FCZ around Guam and the CNMI. The major objectives of the program in order of priority are to:

1. Determine resources of commercial potential;

2. Estimate the magnitude, range, and seasonal variation in availability and abundance of these resources;

3. Estimate their probable levels of sustained harvest; and

4. Add to the knowledge of the biology of the region.

POTENTIAL RESOURCE GROUPS

To date there have been four resource survey cruises by the NOAA vessel <u>Townsend Cromwell</u> and two cruises of a charter boat, FV <u>Typhoon</u>, on which at least a portion of the time was spent in the Guam and CNMI region.

The results from these cruises along with some commercial catch information are reported in Uchida and Eldredge.[1] Based on these data, the principal species groups in the Guam and CNMI region are assigned rankings based on their relative commercial or potential commercial values (Table 1). From Table 1 four species groups are identified as having considerable commercial or potential commercial value. These species groups are tunas, mackerels (bigeye scad), bottom fishes (snappers and groupers), and deep-water shrimps.

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[1]Uchida, R. N. and L. Eldredge. Manuscr. in prep. Summary of environmental and fishery information of Guam and the Northern Mariana Islands.

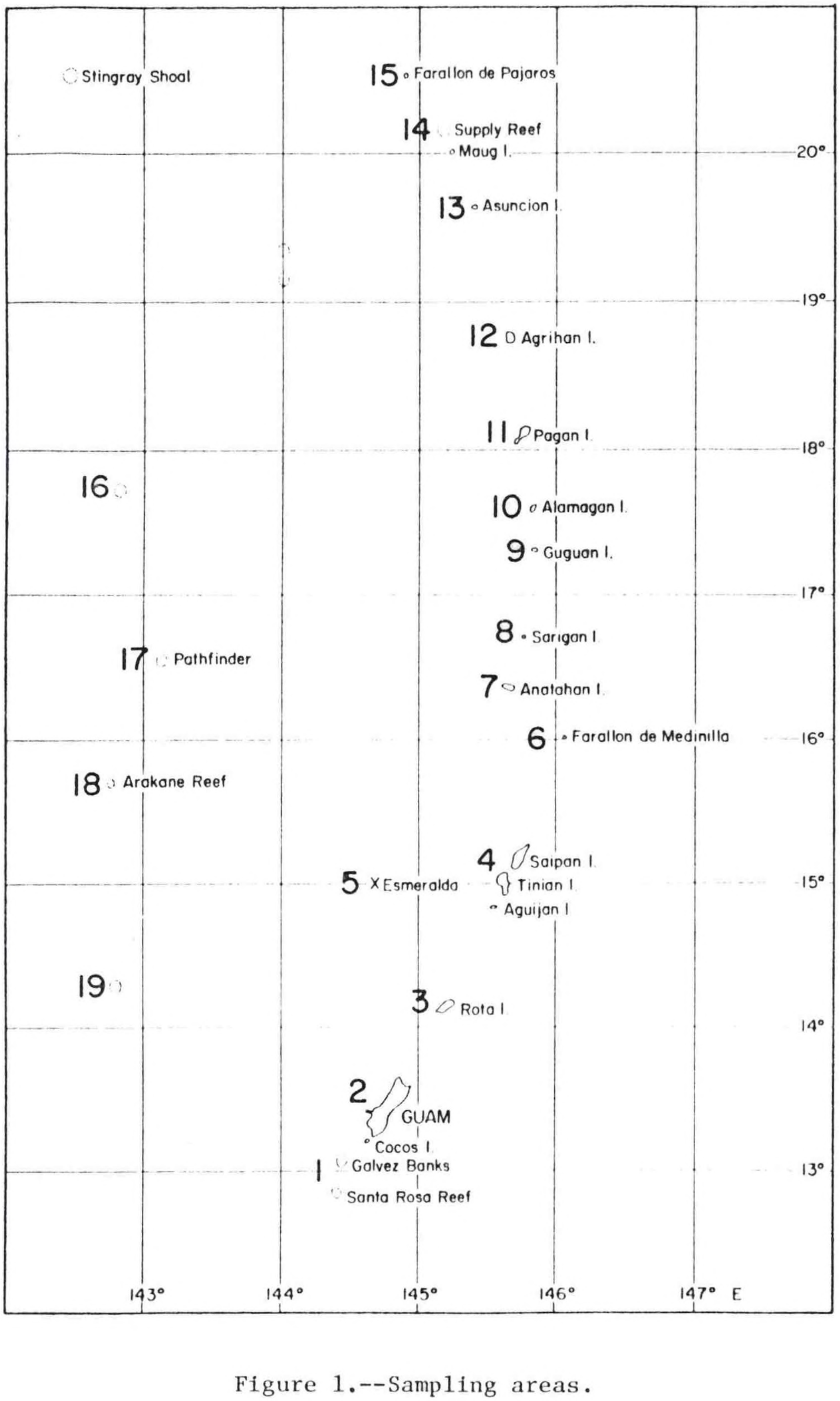

Figure 1.--Sampling areas.

Table 1.—Priority of species for the National Marine Fisheries Service sampling program (L = low, M = medium, and H = high).

Species	Relative potential economic value of resource	Relative importance to local subsistence fishery
Lobsters and crabs	L	L
Reef fishes	L	H
Baitfish (piha)	L	L
Octopus	L	L
Snappers and groupers	M–H	L
Jacks, *Caranx* sp.	M	M
Alfonsin, *Beryx* sp.	L–M	L
Mackerel scad, *Decapterus* spp.	L	L
Bigeye scad, *Selar*; *Trachurops*	M–H	H
Mackerel, *Scomber japonicus*	L	L
Squid	L	L
Shrimp	M–H	L
Rainbow runner, *Elagatis bipinnulata*	M	M
Yellowfin tuna, *Thunnus albacares*	H	M
Skipjack tuna, *Katsuwonus pelamis*	H	M
Kawakawa, *Euthynnus affinis*	L	L
Turtles and whales	L	L
Sharks	L	L
Others	L	L

The tunas are a resource of proven value and are currently fished by foreign bait boats and longliners. As an indication of the abundance of tunas in the area, in 1977 Japanese bait boats and longliners caught 8,870 metric tons (MT) of tunas in the FCZ around Guam and CNMI. There is considerable detailed catch and effort data from the Japanese bait boats and longliners, and it would be pointless to have the *Townsend Cromwell* undertake any general sampling for tunas. However, it would be extremely interesting to undertake a limited amount of sampling to locate sites with potential for a night handline fishery for tunas similar to the Hawaiian ika-shibi fishery. The Hawaiian night handline fishery off the island of Hawaii is conservatively estimated at $2-$3 million annually. The yellowfin tuna is one of the principal species in the Hawaiian night handline fishery. The Japanese longline catch of this species south of Guam, is very comparable to that of Japanese longliners off the island of Hawaii, indicating the resource for a night handline fishery off Guam exists. The night handline tuna fishery would be ideal for the Guam and CNMI region because it is neither labor nor capital intensive and Guam has excellent air shipping schedules to the Japanese market. However, to date, a night handline fishery has not developed in Guam because productive fishing grounds have not been found.

The akule or bigeye scad, *Trachurops crumenophthalmus*, (called atulai in Guam) is probably second in commercial importance after tunas for the Guam and CNMI area (Uchida and Eldredge, footnote 1). The Guam Aquatic and Wildlife

Resource Division reported that the estimated catches from inshore runs around Guam in 1979 was 15 MT. The Townsend Cromwell 1978 survey found that akule occurs in substantial numbers in waters around the high islands and over the offshore seamounts and banks. Sampling for akule from the Townsend Cromwell will employ night lights and handlines to estimate relative abundance throughout the chain. In addition aerial survey methods will also be employed on several occasions to obtain "instantaneous" estimates of akule biomass around the islands and over the banks.

Fishes of the snapper and grouper complex have been caught in good numbers around the high islands and over the seamounts. Species which appear most abundant include: onaga, Etelis carbunculus; lehi, Aphareus rutilans; an unidentified grouper, Epinephelus sp.; black carangid, Caranx lugubris; gindai, Rooseveltia brighami (= Pristipomoides zonatus), yellowtail kalikali, P. auricilla; ehu, Etelis marshi; pink kalikali, P. sieboldii, and yellow-eye opakapaka, P. flavipinnis. On one cruise during a total of 16 days of fishing around seven high islands in the CNMI, the FV Daikatsu Maru caught 8.5 MT of bottom fishes (Uchida and Eldredge, footnote 1).

Sampling gear for the bottom fishes will be bottom handlines. In addition to sampling to estimate relative abundance, intensive fishing at a small isolated pinnacle and a follow-up of the intensive fishing which occurred in 1967-68 at Haputo Pinnacle off Guam reported in Ikehara et al.[2] will be undertaken to estimate absolute abundance.

There are two species of deep-water shrimps which have been trapped in waters around Guam and CNMI. Hetercarpus ensifer is typically found in depths from 100 to 400 fathoms, and H. laevigatus is typically found between 250 and 600 fathoms (Uchida and Eldredge, footnote 1). There are three banks, Galvez Banks, south of Guam; Esmeralda Bank, west of Tinian; and what appears to be a large but poorly charted bank around Farallon de Medinilla north of Saipan, plus the banks around the islands of Guam, Saipan, and Tinian which in total may contain as much as 1,500 nmi^2 of shrimp habitat. These and other banks and seamounts will be sampled with wire-mesh traps.

SAMPLING SCHEME

Relative Abundance

The target species for our relative abundance survey will be bottom fishes, shrimps, and mackerels. Our unit of measure of relative abundance will be catch per unit effort (CPUE) based on a fixed or constant fishing effort. For example, our measure of relative abundance of bottom fish will be CPUE computed on the basis of four lines fishing for 1 h. At a given location, we may have several hours of fishing with four lines and in this case, we will compute a CPUE based on the first hour of fishing, another CPUE based on the second hour, and so forth. We will use these multiple CPUE

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[2]Ikehara, I. I., H. T. Kami, and R. K. Sakamoto. 1970. Exploratory fishing survey of the inshore fisheries resources of Guam. Proc. 2d CSK Symp., Tokyo, p. 425-437.

values at a given site as replicates. The principal reason for computing CPUE values on a constant amount of fishing effort is that the variance of the CPUE estimate is inversely proportional to the amount of effort. If CPUE estimates are all based on the same amount of effort, then comparisons of CPUE between sites and seasons can be performed with an ANOVA model, because the assumption that the observations have equal variances should be satisfied.

Our sampling scheme to chart relative abundance consists of a systematic sample possibly followed by a stratified sample applied to regions of commercial potential if additional precision is required. In many sampling programs, the goal is to estimate a single population parameter, e.g., the proportion of the population that will vote for a specific candidate. In a stock assessment survey where we know that the abundance is heterogeneous, the mean population catch rate is of little value. More important is a chart of the distribution of abundance or relative abundance over the geographic region covered by the survey. In this case, the usual sampling approach such as a simple random sample or stratified random sample is not as efficient as a systematic sample. In systematic sampling, events are sampled in a regular fashion.

In our situation, the geography of the region suggests 19 distinct sampling areas consisting of 6 reefs and seamounts and 13 islands (Figure 1). A 5-day sampling scheme has been developed to collect sufficient data necessary for shrimp, bottom fish, and akule abundance and yield estimation (Table 2). The first field survey period for the Townsend Cromwell is scheduled to run from mid-March through August 1982. During this period the Townsend Cromwell will undertake a 22-day bathymetric cruise followed by 3 biological cruises of approximately 40 days each. These three biological cruises will enable us to sample each island/seamount once for 5 days. (Guam, Saipan, and Farallon de Medinilla due to their area will be sampled for 8 rather than 5 days.) In addition, two areas, Pagan Island in the upper part of the chain and Esmeralda Bank in the lower part, will be sampled on each of the three cruises to provide an estimate of the variation in CPUE over the 5-month survey period.

The Townsend Cromwell cruise schedule is given in Table 3. Tentative cruise tracks are given in Figures 2, 3, and 4.

After the completion of the systematic sampling program, regions of abundance sufficient for commercial exploitation will be identified and subsequent sampling in these regions during the following survey period may be undertaken to improve the physical definition of these regions and reduce the variance of our CPUE estimates.

Yield Estimates

Several approaches will be used to determine yield estimates. If there is a record of commercial catch and effort statistics for a resource, then production analysis based on a regression of CPUE against effort will be used to estimate sustainable yield and the corresponding fishing effort. For bottom fishes, shrimps, and possibly mackerels, if there are no commercial catch and effort data, then we will conduct intensive fishing experiments at small and isolated geographic sites and use the Leslie method based on the

Table 2.--Sampling task itinerary for bank or seamount.

Day 1 -	Arrive at bank Handline for bottom fishes Set shrimp traps Night handline for akule
Day 2 -	Handline for bottom fishes Recover and reset shrimp traps Night handline for tunas
Day 3 -	Handline for bottom fishes Night handline for akule
Day 4 -	Handline for bottom fishes Set shrimp traps Night handline for akule
Day 5 -	Recover shrimp traps Troll to next sampling area (island/seamount)

Table 3.--Cruise schedule for *Townsend Cromwell* for FY 1982.

February 6 to 19	- Transit to Honolulu	14 days
February 20 to 22	- In port	
February 23 to 25	- Shakedown cruise	3 days
February 26 to 28	- In port	
March 1 to 18	- Transit to Guam	18 days
March 19 to 22	- In port, Guam	
March 23 to April 13	- Bathymetric cruise	22 days
April 14 to 16	- In port	
April 17 to May 7	- Biological cruise I-A	21 days
May 8 to 10	- In port	
May 11 to 30	- Biological cruise I-B	20 days
May 31 to June 2	- In port	
June 3 to 22	- Biological cruise II-A	20 days
June 23 to 25	- In port	
June 26 to July 17	- Biological cruise II-B	23 days
July 18 to 20	- In port	
July 21 to August 5	- Biological cruise III-A	16 days
August 6 to 8	- In port	
August 9 to September 3	- Biological cruise III-B	25 days
September 4	- In port	
September 5 to 22	- Transit to Honolulu	18 days
		200 days

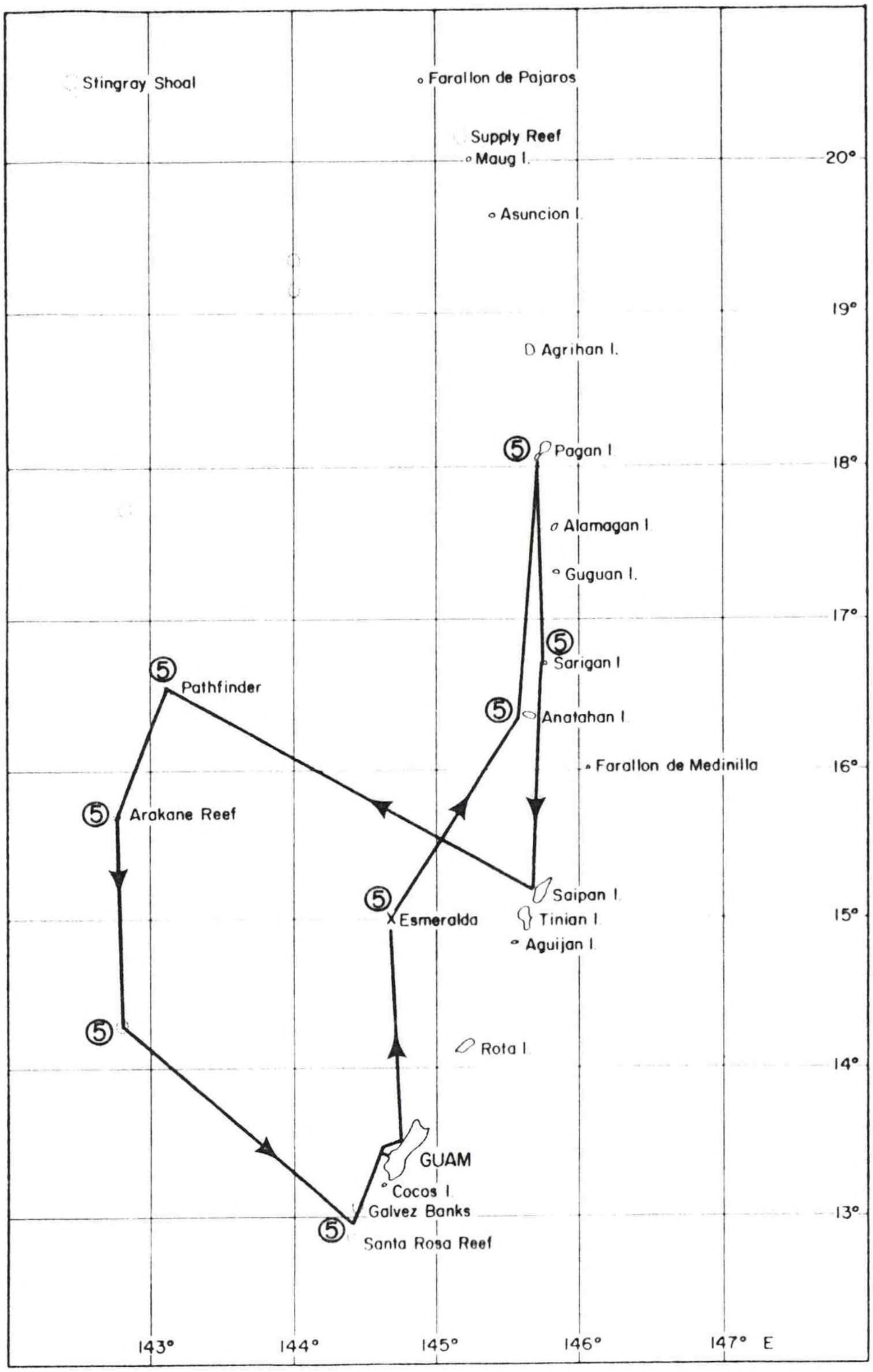

Figure 2.--Biological cruise 1-A = 21 days
1-B = 20 days
(5) indicates number of days sampling.

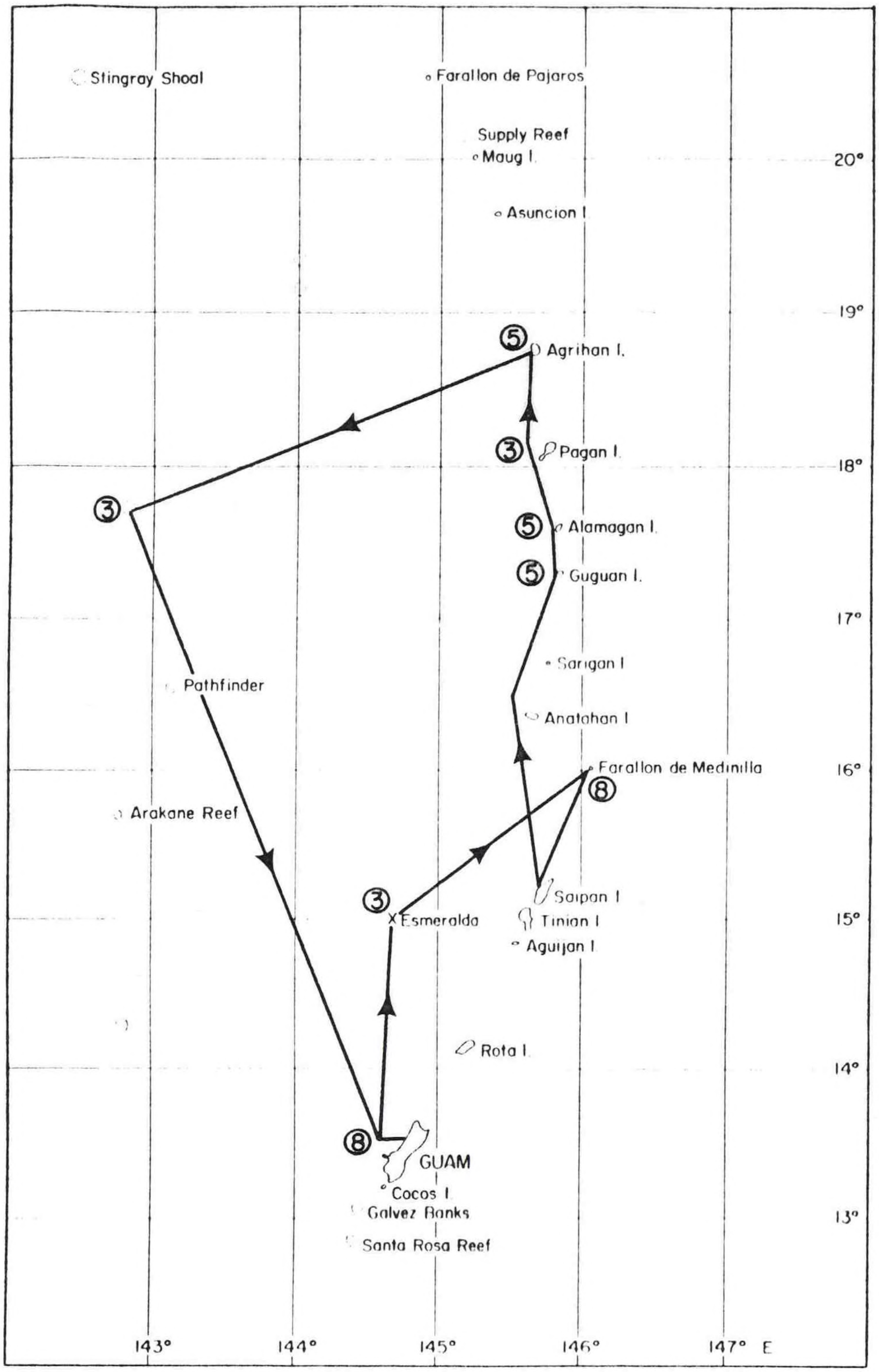

Figure 3.--Biological cruise II-A = 20 days
II-B = 23 days
(5) indicates number of days sampling.

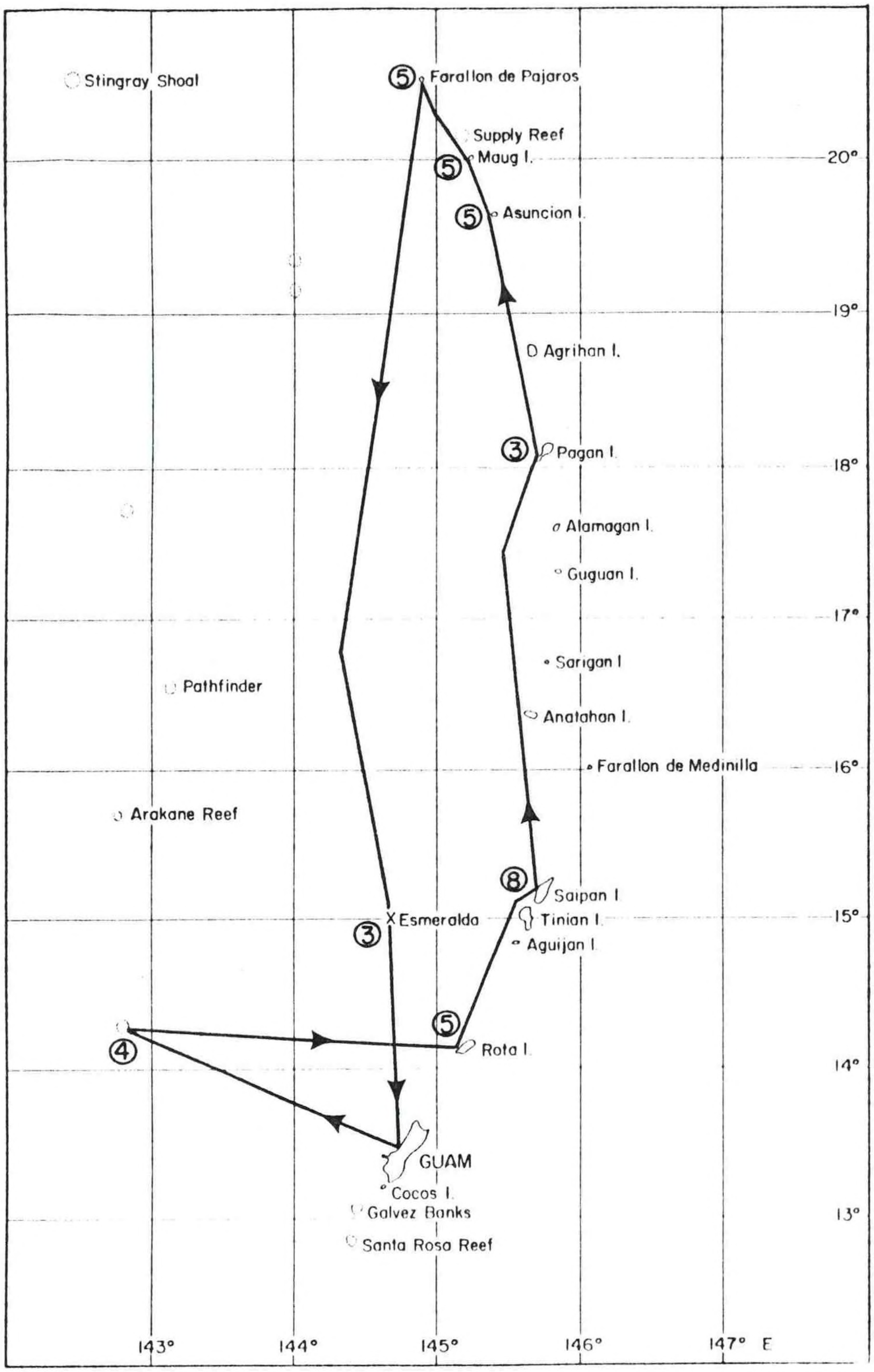

Figure 4.--Biological cruise III-A = 16 days
III-B = 25 days
(5) indicates number of days sampling.

regression of CPUE against cumulative catch to estimate catchability and initial biomass. We can convert the initial biomass to a density estimate by dividing the biomass by either the length of an appropriate depth contour or the area of habitat to obtain, for example, kilograms of bottom fish per kilometer of 100-fathom contour, or kilograms of bottom fish per square kilometer. We can use the correspondence between CPUE and density at the intensive fishing site to estimate density and, subsequently, biomass at all the regions, where relative abundance (CPUE) estimates have been obtained. For example, if we wish to determine density at some site "A" based on a CPUE at site "A," then:

$$\text{Density of site "A"} = \left[\begin{array}{l}\text{Density at}\\ \text{intensive}\\ \text{fishing site}\end{array}\right] \times \left(\frac{\text{CPUE at site "A"}}{\text{CPUE at intensive fishing site}}\right).$$

Typically estimates of biomass and catchability will not be sufficient to estimate sustainable yield. However, given estimates of virgin biomass (B_o) for stocks of bottom fishes, shrimps, and mackerels estimated from intensive fishing experiments, an estimate of the maximum yield (C_{max}) from these stocks can be obtained from either Gulland's relationship:

$$C_{max} = 0.5 \times M \times B_o$$

where M is the instantaneous natural mortality or from Pauly's[3] relationship:

$$C_{max} = 2.3 \times \left(\omega^{-0.26}\right) \times B_o$$

where ω is the mean of the weight at first maturity and the maximum weight of the fish in the stock (in grams).

Data To Be Collected

The existing bathymetric data for the survey region are limited. Many banks are poorly charted and in some cases the existence of some seamounts is uncertain. The survey program will begin with an initial cruise of 22 days to obtain the bathymetric data for important seamounts and banks around Guam and Saipan. Some hydrographic data will also be collected on this cruise.

After this initial cruise the biological sampling will begin in accordance with the previously defined sampling program. The data to be collected for each species group are indicated in Table 4. The specific itinerary of a 5-day sampling program at a bank or seamount is given in Table 2.

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[3]Pauly, D. 1981. Studying single-species dynamics in a tropical multispecies context. Paper prepared for ICLARM/CSIRO Workshop on the Theory and Management of Tropical Multispecies Stocks, 12-23 January 1981, Cronulla, Australia, 65 p.

Table 4.--Data to be collected by species groups.

SHRIMPS

1. CPUE data to estimate relative abundance by bank, depth, and season.
2. Length-frequency data at specific sites over time to estimate growth curves and subsequently mortality.
3. Morphometric and fecundity data.

BOTTOM FISHES

1. CPUE data to estimate relative abundance by bank, depth, and season.
2. Length-frequency data at specific sites over time to estimate growth curves and subsequently mortality.
3. Intensive fishing CPUE data to estimate absolute biomass.
4. Morphometric and fecundity data.

TUNAS

1. Night handline CPUE data by bank to locate sites of ika-shibi potential.

MACKERELS

1. CPUE data to estimate relative abundance by bank and season.
2. Length-frequency data to estimate growth and mortality.
3. Tagging results to estimate migration.
4. Morphometric and fecundity data.

OTHER SAMPLING AS TIME PERMITS

1. Tangle nets and inshore diving to sample for lobsters.
2. Bottom gill nets for bottom fishes.

THE DATA MANAGEMENT SYSTEM

The data system for the storage and analysis of the survey data is presented schematically in Figure 5. The heart of the system is the Statistical Analysis System (SAS)[4] files which are based on a packaged software system supported by the University of Hawaii IBM 370 for data base management. These SAS files enable data entered and stored in one format to be subsetted or re-formated and used in subsequent analyses. After each cruise computer-generated charts of relative abundance for each species sampled will be produced and survey summaries will be generated to insure that the data collected are reviewed and available for any revisions which may be necessary in the sampling plan. Data from the SAS files will also be used for specific analysis such as morphometric and growth curve analysis.

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[4]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

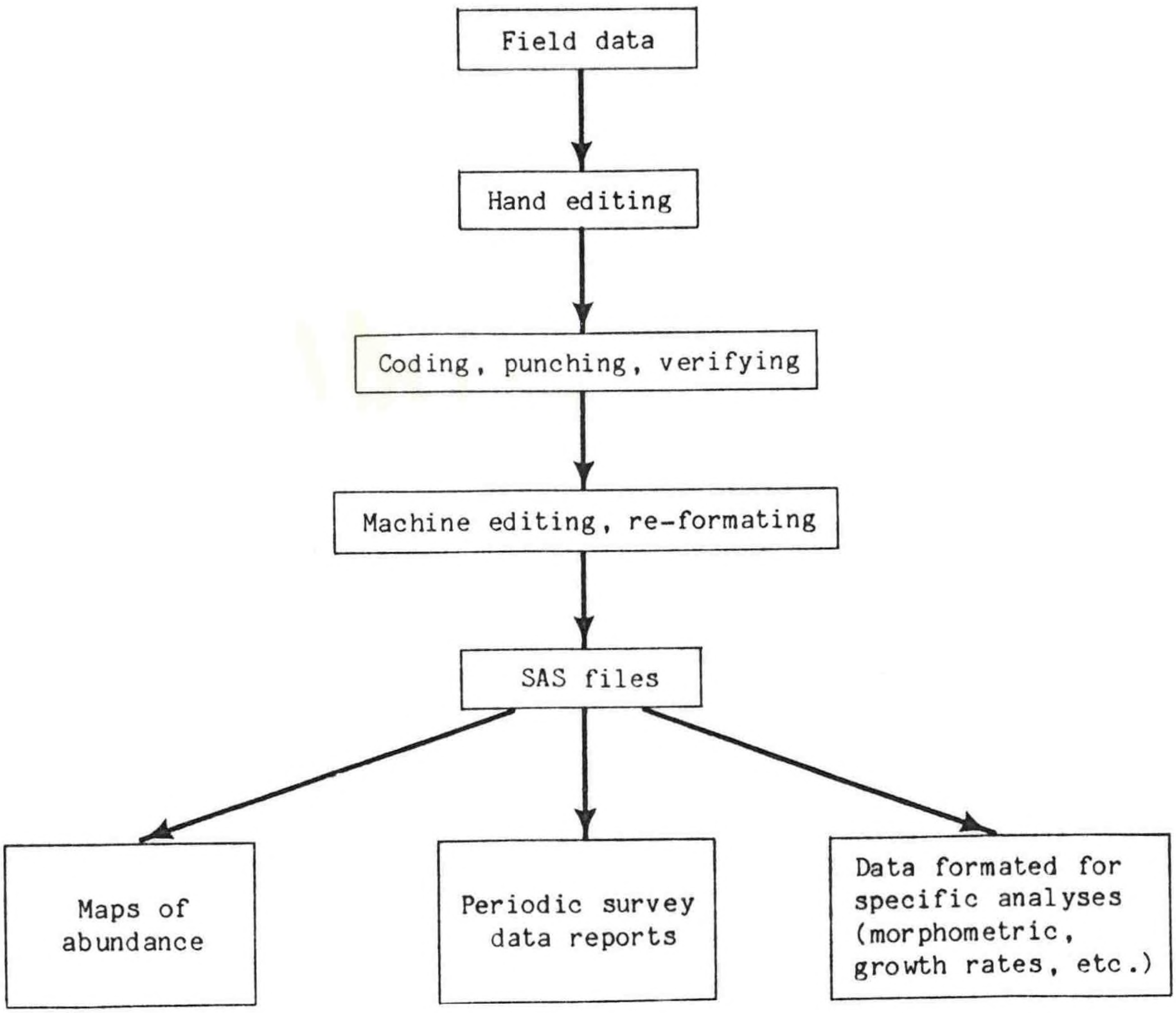

Figure 5.—Schematic of data base system for sampling data.