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REPORT ON THE ELECTROPHORETIC AND MORPHOMETRIC STUDIES CONDUCTED AT THE INTER-AMERICAN TROPICAL TUNA COMMISSION FROM 1969 TO 1978

by — por
William P. Kane

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INTRODUCTION

Knowledge of the population structure of an exploited stock is necessary for the effective management of a fishery. For this reason the Inter-American Tropical Tuna Commission (IATTC) has sponsored numerous genetic, morphometric, and migration studies of yellowfin, *Thunnus albacares*, and skipjack, *Katsuwonus pelamis*, in a concerted effort to determine the structure of these stocks in the eastern Pacific Ocean.

This report focuses on studies conducted by two Commission scientists, Drs. Gary D. Sharp and Robert C. Francis, from 1969 to 1978, which involved the collection and analysis of electrophoretic (Sharp) and morphometric (Francis) data. The initial analyses, results, and conclusions of these studies have been reported in IATTC bi-monthly and annual reports (1970-1977) and in publications by Sharp (1969, 1972, 1973), Sharp and Francis (1976), and Sharp and Pirages (1978). In these reports the data were presented in abbreviated formats summarized by sample or area, and as a result of numerous manipulations and reanalyses of these data over the years their original character has been obscured. Consequently, recent attempts to verify earlier results and reanalyze conclusions have been hampered by incomplete data sets and apparent inconsistencies among data in different reports. The purpose of this report is to describe, as clearly as possible, the procedures involved in the collection, analysis, and storage of the electrophoretic and morphometric data and to reconstruct the data base in its entirety from the original electrophoretic and morphometric records so that these data will be readily accessible to other researchers.

This report has been divided into three principal sections, History, Materials and Methods, and Data. The History section is an historical outline of the samples collected and the analyses performed. The Materials and Methods section is a detailed description of the techniques employed for the collection of specimens and data and the laboratory analyses of the blood and tissue samples. Descriptions of the various types of data which are available are contained in the Data section. The reconstructed data base consists of two data files, one for yellowfin and one for skipjack. Each data file contains the genetic, morphometric, and collection (area, date, gear, etc.) information for each sampled fish. Because the data files are too large to be included in this volume the genetic data have been summarized by sample in Appendices 6 and 7. The complete data files are available on request from the IATTC in either a printed format or on computer magnetic tape. The information reported here was extracted directly from the electrophoretic gel records and original collection data. In all cases where inconsistencies existed in the data or where information was unclear, a number of sources were consulted.

GLOSSARY OF TERMS

Blood (sera) sample: Four to 5 ml of whole blood taken from a fish using a plastic Peel-A-Way blood sampler. Each sampler was labeled with a sample code and either the length of the fish or an identification number.

Blood or tissue survey: A procedure where a number of blood or tissue samples are electrophoretically analyzed for a number of specific enzymes in a search for polymorphic enzyme products.

Cores and drains: Samples of blood taken from fish which had been frozen.

Data file: A collection of the genetic and morphometric data for each sampled fish and a sample index to identify each sample. There are two data files, one for yellowfin and one for skipjack.

Electrophoresis: The separation and identification of protein (enzyme) bands using an induced electric field and histochemical staining.

Electrophoretic gel (starch gel or gel): A horizontal glass plate filled with hydrolyzed starch used in the electrophoretic process as a matrix for the separation of proteins.

Electrophoretic gel notebooks: A collection of eight notebooks and one folder containing the electrophoretic gel records.

Electrophoretic gel records: The records of the phenotypes assigned to the pattern of enzyme bands of blood or tissue samples after electrophoretic analysis.

G code: A coding system used to identify samples which have associated morphometric data. The code consists of the letter G and a three-digit number.

Green cruise logbooks: Green bound books containing a daily record of the scientific observations and experiments of the IATTC staff aboard a chartered fishing vessel or tagging cruise.

Morphometric data sheets: Formatted records of the measurement of external body dimensions collected from yellowfin and skipjack. These sheets have been partially categorized by year in the morphometric notebook.

Morphometric notebook: A black three-ring binder labeled "Morphometric sheets" containing the original morphometric data sheets.

Phenotypic score: Code assigned to a band or group of protein bands which appear on a starch gel after a tissue or blood sample has been electrophoresed and the proteins have been selectively histochemically stained. It is assumed that the phenotypes (protein banding patterns) recorded represent genetic (DNA) products.

Sample: A collection of typically 200 blood samples and/or 50 sets of morphometric measurements taken from fish captured in one purse-seine set or during one baitboat stop.

Sample Code: Two to six characters used to identify a sample. Lists of sample codes and sample collection data are given in the sample indices (Appendices 3 and 4).

Sample (collection) data: Data concerning the location, date, and gear employed in the capture of the fish used for a blood and/or morphometric sample.

Sample folder: A manila folder containing sample data, copies of the electrophoretic gel records, and morphometric data sheets used to compile the data. Folders are categorized by year of capture and may contain from one to four samples.

Sample index: A table of sample codes, sample data, morphometric codes, and the dates of electrophoretic analyses used to cross reference samples that have been reported earlier. There are two sample indexes, one for yellowfin (Appendix 2) and one for skipjack (Appendix 3).

Sample summary: A summary of the phenotypic scores of each sample. There are two sample summaries, one for yellowfin (Appendix 6) and one for skipjack (Appendix 7).

Sampling instructions: Detailed instructions given to waterfront and at-sea personnel describing the techniques and areas that were to be employed in blood and morphometric sampling. A collection of these instructions can be found in Appendix 2.

Standard reference sample: A collection of four samples (CAC FF, CAC GG, CAC HH, CAC II) of yellowfin blood collected in one small area over a 4-day period.

Summary sheets: A summary created by Sharp from the electrophoretic gel records of the distribution, by size of fish, of the phenotypic frequencies of a sample.

HISTORY

Yellowfin sampling in the eastern Pacific

1969

Due to the expansion of the yellowfin surface fishery into offshore areas in 1968, the IATTC staff felt a need to reevaluate and extend earlier population studies using genetic (blood typing and immunological) and morphometric techniques. The purpose of these studies was to elucidate the population structure of eastern Pacific yellowfin. The proposed null hypothesis was that yellowfin in the eastern Pacific, both within the IATTC's Yellowfin Regulatory Area (CYRA) and in the offshore areas, belong to one homogeneous population. This hypothesis was to be tested using gene frequencies determined from electrophoretic studies and standard numerical population genetic techniques. It was assumed in these studies that samples whose allelic frequencies closely approximated the expectations of a Hardy-Weinberg equilibrium distribution were from similar origins and belonged to the same population, and samples whose allelic frequencies diverged from the expected were assumed to be the product of a mixture of fish from different genetic units or subpopulations.

The initial program consisted of the collection and electrophoretic analysis of yellowfin tissues for polymorphic loci and the determination of the variation and frequency of occurrence of these allelic characters in several geographic regions of the eastern Pacific Ocean. The following enzymes were assayed for polymorphisms:

1)Lactate dehydrogenase (LDH)
2)Glucose-6-phosphate dehydrogenase (G6PDH)
3)Glutamate dehydrogenase (GDH)
4)Na-alpha-glycerophosphate dehydrogenase (alpha-GDH)
5)Phosphoglucomutase (PGM)
6)Alcohol dehydrogenase (ADH)
7)Transferrins (TFN)
8)Esterases (EST)

The samples employed in these early surveys were collected on two simultaneous IATTC tagging cruises during October and November 1969. Cruise 1054 was aboard the baitboat *Mary Carmen*, and Cruise 1055 was on the purse-seiner *Connie Jean*. Approximately 400 yellowfin blood samples representing 5 distinct schools were collected, along with blood samples from 36 black skipjack, *Euthynnus lineatus*, and assorted other scombroid species taken on jig lines trolled behind the vessels. The techniques employed in the collection of blood samples are described in the Materials and Methods section of this report. The exact number of tissue samples taken during these cruises is unknown. It can be assumed, however, that most, if not all, of the 400 yellowfin used in the blood collection were also used as a source of tissue samples, because the sex is recorded for each fish and both sex determination and tissue sampling require dissection. Heart, muscle, liver, and a number of stomachs were dissected from the freshly-caught fish, and stored at -10°C. Morphometric measurements were collected from 76 yellowfin. For each of these fish 11 measurements were recorded. In order to examine the variability between measurers, a number of the fresh fish were measured independently by two people. To determine the effect of the freezing process on the morphometric measurements each fish was measured twice, once immediately after capture and again during unloading after being frozen in brine aboard the vessel.

The laboratory analysis of the blood and tissue samples began in December 1969. The micro starch gel method of Tsuyuki et al.(1966) was used to separate the proteins electrophoretically. The zones of activity for each enzyme were then determined by a specific stain or, in the case of transferrins, by the autoradiographic technique of Barrett and Tsuyuki (1967). A complete listing of the stains and buffers with references is given by Sharp (1972: Addendum 1) (Appendix 1 of this report).

The results and conclusions of the early enzyme surveys were published in the IATTC bi-monthly report series. In the January-February 1970 issue it was reported that reproducible electrophoretic banding variants had been observed in yellowfin red blood cell LDH. Analysis of this enzyme system in yellowfin and other scombrids continued until July 1970, when it appeared that the observed variation was the result of the random expression of several tissue-specific LDH isozymes. Because the necessary facilities were not available to do a complete biochemical analysis, the LDH system was considered to be of no further value as a population discriminator. Similarily, the four remaining dehydrogenases and the mutase were eliminated as useful enzyme systems because they were too complex (GDH, alpha-GDH), monomorphic (ADH, G6PDH), or the resolution of the banding patterns was poor (PGM). This left only transferrins and esterases, which had previously been shown to be polymorphic by Barrett and Tsuyuki (1967) and Fujino and Kang (1968a, 1968b), as possible useful enzyme systems.

Many difficulties were encountered in the early stages of the analysis for serum esterases. Variability which could not be fully accounted for on a genetic basis was observed using the techniques of Fujino and Kang. These difficulties were resolved by consulting with Dr. Fujino in March 1970, and the results of the esterase analysis of the initial 400 blood samples were reported in the IATTC May-June 1970 bi-monthly report. Details of the esterase system are given in the Materials and Methods section of this report. In 1971 these blood samples were reanalyzed to check for scoring reliability and the stability of the esterase enzyme. The phenotypic scores of both analyses can be found in the yellowfin sample summary (Appendix 6). The 1970 results are coded with a number 1, (CNJ A1, MRC B1, MRC C1, CNJ D1 and CNJ E1), while the 1971 scorings are coded with a number 2 (CNJ A2, MRC B2, MRC C2, CNJ D2 and CNJ E2). A more detailed description of these samples and the scoring records can be found in the Data section of this report.

No difficulties were encountered in the characterization of serum transferrins using the standard techniques of Barrett and Tsuyuki (1967). Although they could uncover transferrin zones using an amido black stain, Barrett and Tsuyuki did not employ this method in their study because of their limited knowledge of the allelic structure of the transferrin system, and because precise definition of the bands was not always possible using the micro starch gel techniques. Given the superior resolution of the Fujino techniques, it was possible in 1970 to abandon the costly radiographic process for a simplified double-staining procedure. After electrophoresis each gel was stained twice. First, the gel was stained for esterases. These bands formed within 10 minutes and could easily be scored. After recording the esterase phenotypes the gel was stained with an amido black solution. After a few minutes the stain was removed, the gels were cleared, and the transferrin phenotypes recorded. The details of this process can be found in Sharp (1972: Addendum 1)(Appendix 1 of this report).

1970

From 1970 to 1974 Sharp collaborated with the staff of Dr. N.O. Kaplan's laboratory at the University of California at San Diego (UCSD). Difficult-to-assay enzymes, particularly LDH and isocitrate dehyrogenase, were examined using gel electrophoresis, electrofocussing, and column chromatography. No polymorphisms were encountered. Additionally, Drs. S. Y. Yang and M. E. Soule of the UCSD genetics department were consulted during the course of these investigations.

The results of the initial screening limited the materials to be collected for population discrimination to whole bloods because only the serum transferrins and esterases appeared to be useful in this respect. Dr. Fujino was not optimistic in discussions concerning the use of these enzymes to describe yellowfin subpopulations because, in his analyses of transferrin gene frequencies of samples taken from various areas of the Pacific, he had found no significant heterogeneity in either intra-area or inter-area comparisons for eastern Pacific, Hawaiian, or Line Islands yellowfin (IATTC March-April 1970 bi-monthly report). These discussions were to lead to the development of the 1970 sampling program. The goal of this program was to determine the statistical sampling requirements to define rigorously the levels of gene frequency variation within the sampled population(s), particularly gene frequency variations with size-age. A major component of this sampling program would involve the collection of a 2000-fish "standard reference sample." It was hypothesized that the reference sample (collected in 1971) would represent the true population gene frequency for the sampled area. This sample would then be used to set optimum sampling requirements for the discriminate analysis of fish in time and space. A complete description of the experimental design and its assumptions and limitations is given by Sharp, Mobrand, and Francis (1970). A summary of the hypotheses and the equations employed is given by Sharp (1972: Addendum 2)(Appendix 1 of this report).

It was hoped that this avenue of research would lead to the description of separate areal groups for yellowfin. A total of 25 samples was collected from June to December 1970. Three purse-seine cruises were involved, two aboard the Anne M. (Cruises 1057 and 1058) and one aboard the Marietta (Cruise 1059). These samples are coded ANM (B through K) and MRT (L1 through XN) in Appendices 3 and 6. Whole blood samples were taken from as many fish as possible over a wide range of lengths. Lengths were recorded in either centimeters or millimeters and kept in bound books referred to in this report as green cruise logbooks. Each fish and each blood sampler was given an identification number so that the lengths and genetic data could be correlated.

Upon arrival at the laboratory blood samples were analyzed using the double-staining technique, and the esterase and transferrin phenotypes were recorded. As these data were collected each fish in each sample was alloted a computer card (1971 computer cards) on which was recorded the sample code, the date and location of capture, the length of the fish (usually to the nearest centimeter), sex (if known), and the electrophoretic phenotypes. To facilitate further analyses, the data from the 400 blood samples collected for the initial survey in 1969 were also recorded on computer cards in 1971. Regrettably, it is now impossible to match with certainty a computer card to an individual fish because the fish identification numbers were not included on the computer cards. For this reason the computer cards, although available, were not used to compile the yellowfin data. The data used in the yellowfin sample summary (Appendix 6) and the yellowfin data file were taken from the original electrophoretic gel records, recorded on loose-leaf paper, using the fish identification numbers to correlate the genetic data with the lengths recorded in the green cruise logbooks.

In subsequent analyses of the above data it became apparent that the complexity of the data (the level of heterogeneity in gene frequencies both within and among samples) would not allow the description of "separate areal groups" of yellowfin. This discovery resulted in the restructuring of the sampling program for the following year.

1971

The 1971 sampling program was devised to provide samples which would contain large numbers of fish recruited to the fishery during one quarter of the year from areas believed to be relatively isolated with respect to stock mixing. This study was based on the hypothesis that samples of fish hatched in the same quarter of the year would have similar esterase and transferrin gene frequencies. Because most of the sampling was done in November it was decided that all fish in the samples would be given a relative age standardized to November 15 and adjusted by 3-day intervals to 10ths of months. In this manner fish were assigned to one of four quarterly entry groups by their lengths. Quarter Q1 was from February to April, Q2 from May to July, Q3 from August to October, and Q4 from November to January. A computer program, POP-DIF, was developed for aging the fish based on the growth curves created by Davidoff (1963) from time-dependent modal progressions observed in length-frequency data. This computer program performed a Chi-square analysis of each sample by size groups. The program first divided the sample into size groups, and then computed the allelic frequencies for each size group and for the entire sample. After determining the frequencies, it would test the fit of these frequencies against those expected from a Hardy-Weinberg equilibrium. Finally, the total, pooled, and heterogeneity Chi-squared values were determined. A major part of Sharp (1972) deals with the analysis of these quarterly entry data, and for further details one should consult that report.

From April to November 1971 a series of large samples was collected in an attempt to insure size homogeneity. Sampling was directed at fish less than 2 years of age, and maximum effort was expended in areas where traditionally large numbers of small "school-fish" (fish not associated with porpoise) were encountered. Three purse-seine tagging cruises were involved. On the Pacific Tradewinds (Cruise 1062) seven samples were collected, (PTW 10, 12, 27, 37, 42, 45, and 52). Each sample was coded by the number of the net set from which the sample was taken. Samples PTW 10 and PTW 12, which were composed of fish taken from three sets (10, 11, and 12), were combined into one sample in many of the analyses. During Cruise 1063 of the J.M. Martinac five samples were collected which have been labeled, JMM AA, JMM BB, JMM CC, JMM DD, and JMM EE. During Cruise 1064 aboard the Cachita five more samples were added (CAC FF, CAC GG, CAC HH, CAC II, and CAC JJ). Four of the five Cachita samples (CAC FF, CAC GG, CAC HH, and CAC II) were collected in a "small time-area stratum" (September 9-13 at approximately 23°N-113°W). These fish represented in nearly equal proportions "age cohorts" from the first two quarters of the year, Q1 and Q2. This set of four samples was the most homogeneous (in size and time) group of samples collected, and when combined into a single sample was referred to as "the standard reference sample."

In October and November 1971 a series of small samples was collected from unloadings at Manta , Ecuador, and during Cruise 1066 aboard the Marco Polo. Samples ECU XA, ECU XB, ECU XX, and ECU JC were collected at the Inepaca cannery. Samples ECU XA and ECU XB are samples of approximately 28 fish, while ECU JC is a combination of several small samples. Sample ECU XX was collected by Sharp at the Inepaca cannery, and because cannery samples came from mixed schools of fish he grouped this sample with ECU XA and ECU XB into one large sample labeled "XX." Many of the small samples collected during Cruise 1066 were combined into a single large sample labeled "WB" (Sharp, 1972). In the yellowfin data file these samples have, where possible, been separated into their component parts, resulting in four samples for Cruise 1066 (MP A1, MP BC, MP D1, and MP E1). Most of the data collected and the analyses performed during 1971 were described in the IATTC September-October 1971 bi-monthly report. This report contains, the sample collection dates, locations, the number of fish, and the age group composition by quarters of each of the samples.

1972-1973

In 1972 Sharp and Francis initiated an integrated program for collecting and analyzing several biological parameters simultaneously. This program was to include: 1) blood sampling for genetic analysis (particularly transferrins, as the esterase system did not contain enough variability), 2) morphometric data, 3) basic biological data (collections of gonads for reproductive studies and stomachs for food studies), and 4) migration data as determined from tagging studies. It was hoped that with this collection of data the structure of the yellowfin population(s) in the eastern Pacific could be better defined. Sampling was to be conducted in three general areas which supported continuous fisheries; the northern grounds, fished by San Diego- and Ensenada-based baitboats; the southern areas, fished by Ecuadorian vessels based in Salinas and Manta; and the Central American grounds, fished from vessels based in Puntarenas, Costa Rica. To these were to be added any samples which could be collected opportunistically on tagging cruises.

This new program was designed to evaluate the following concepts:

1) Discrete subpopulations have discrete morphological and genetic characters.
2) The level of genetic frequency variability both among and within samples is of the same order. This was based on the statistical analyses (heterogeneity Chi-square) of samples collected in 1969-1971.
3) Individual yellowfin have only one spawning period per year. The two observed yearly spawning peaks were hypothesized to be the result of two genetically isolated semestral units, A and B. (Although Sharp's A and B semestral units coincide in some cases with Hennemuth's (1961) division of yellowfin into X and Y cohorts, the former is based on genetic considerations

and the latter on modal progressions. Consequently, each system of subdivisions should be considered independently.)

4) Sampling narrow length classes (10 to 15 cm) should increase the chance of genetic relatedness in samples.

5) Statistical sensitivity to small-frequency differences would be enhanced if samples were large (200 or more fish per sample).

6) Samples from different subpopulations which have similar gene frequencies can be differentiated using morphometric techniques.

7) As more data are collected the "sample variance" for both morphometric and genetic data should decrease and take on a central tendency if all the yellowfin in the eastern Pacific belong to one population.

In order to evaluate and further refine these concepts a sampling scheme was designed to increase the probability of genetic relatedness. Samples were to consist of 200 fish whose lengths corresponded to one of a number of 10- to 15-centimeter length modes. A list of expected modes for each month had been tabulated based on modal progressions and given to each person sampling. Morphometric samples were to be composed of a subset of 50 fish from the blood sampling. Nine external body dimensions were to be recorded for each fish. (Appendix 2 contains a collection of sampling instructions, and the Materials and Methods section gives further details on morphometric sampling.) Sampling from tagging cruises was slightly modified from the above in that only 70 fish were taken. Samples of blood and morphometrics during this experimental period were identified using a three-digit code preceded by the letter G. The first sample taken was labeled G150, and the remainder of these samples can be found in the yellowfin sample summary (Appendix 6) by referring to the G codes and associated sample codes in the sample index (Appendix 3).

Initially both blood samples and morphometrics were taken from fresh fish (G150-152), but this procedure was changed for samples G153-157 and G160-161. For these samples bloods were taken from fresh fish as before, but then numbered plastic flags were attached to each caudal peduncle and the fish were frozen in brine. The morphometrics for these fish were collected when the fish were thawed at the cannery just before butchering. The sampling procedure was again changed for samples G159, 163, and 164, and an electrophoretically unscorable sample from the Vikingo. For these samples both blood and morphometrics were taken from thawed fish at the cannery. The details for taking blood from frozen fish, "cores and drains," are given in the Materials and Methods section.

In 1973 the sampling program was altered to take advantage of the possibility of obtaining help from participants in the U.S. National Marine Fisheries Service (NMFS) porpoise observer program, as well as an abundance of small fish being caught in the Gulf of Panama and off Costa Rica during that year. As before, 200 yellowfin bloods and 50 morphometrics were taken from fish thawed at the cannery just before butchering, but only eight morphometric measurements were taken at that time. Each sample was to represent a single purse-seine set or baitboat stop. To aid in the identification of these fish NMFS porpoise observers had been equipped with plastic flags to mark groups of uniformly-sized fish which they encountered. A total of 16 samples, labeled G200-215, were collected in this manner. Additionally, two small samples were collected from Cruises 1070 and 1071. The sample from Cruise 1071 is of particular interest because the 70 fish in that sample were measured twice. Morphometrics were taken at sea on the freshly-caught fish and at the cannery just before butchering. This was to prove useful in explaining some of the variability seen in the morphometric data. Further details on Sharp's analysis of these data and his conclusions are given by Anonymous (1973,1974).

During this period Francis was analyzing the morphometric data. In order to make the morphometrics of fish of different sizes comparable, the measurements for each fish were adjusted to those which would be expected to occur on fish of a standard total length (600 mm). The variance-covariance structure of the adjusted morphometric data was examined by means of a multivariate statistical technique. Then the within-sample variance-covariance structure was examined by means of a principle component analysis. Finally, a series of analyses were performed on three sets of replicate morphometric samples taken at sea and subsequently at the cannery from thawed fish. All three samples were taken during tagging cruises aboard the purse-seiner Marietta, two in 1970 (Cruise 1059) and one in 1973 (Cruise 1071). These data can be found in the morphometric notebook, and the analyses of these data were described by Anonymous (1974). From these analyses it was concluded that significant changes in the morphometrics had taken place during the freezing-thawing process, and the magnitude of those changes required that all future measurements be taken from fresh fish to avoid additional random as well as systematic errors.

1974-1976

The simultaneous collection of yellowfin blood and morphometric samples continued for three more years (1974-1976). The sampling design, underlying concepts, and assumptions first expressed in 1972 were retained, the only difference from the earlier studies being the source of the blood and morphometric samples. Because of the variability believed introduced by the freezing-thawing process, frozen fish were no longer used for blood sampling or for the collection of morphometric data. During this period a total of 56 samples of blood and morphometrics was collected from three distinct areas of the fishery. Samples were coded for the area of capture by using G codes. Samples collected off Baja California by San Diego- and Ensenada-based baitboats were labeled with a G300 series, Ecuadorian collections were labeled by a G500 series, and samples taken in the central and offshore areas of the fishery were labeled by a G400 series. A complete listing of the samples is given in the Materials and Methods section under yellowfin morphometric samples. An additional six samples were collected on tagging cruises where only blood samples were taken.

All of the blood samples collected were analyzed electrophoretically in the same manner as the fresh fish samples collected in 1972. After the electrophoretic phenotypes were determined for each blood sample, each sample was analyzed for its genetic homogeneity based on the frequency of the serum transferrin A allele. When the frequency of the allele in a sample was below .660 in the south or below .705 in the north the sample was considered to be a "homogeneous low-frequency" sample. Similarly, when the sample frequency was greater than .780 the sample was considered to be a "homogeneous high-frequency" sample. Samples with intermediate frequencies were viewed as being potential composites or mixtures of genetically high- and low-frequency groups. As in 1972, it was believed that, based on the sample frequency of the transferrin A allele, the genetically heterogeneous samples should exhibit more within-sample morphometric variability than the genetically homogeneous samples.

Francis continued his analysis of the morphometric data, and in 1976 he concluded that, "There is no evidence that morphometric characters presently being examined have any relationship to the serum transferrin gene frequencies being employed to assess subpopulation structure" (Anonymous, 1977). Following a reanalysis of the data in 1981, Francis elaborated on his earlier findings in a memorandum to Dr. John R. Calaprice (Appendix 5). The only systematic differences which Francis was able to detect in the morphometric data relate to levels of allometry among different areas of the eastern Pacific. He determined that, given the limitations of the present analytical techniques, fish length, not area of capture, was a better discriminator of morphometric relatedness. After numerous manipulations of the data and comparing the analyses of transformed and untransformed data sets, he further concluded that the stepwise canonical analysis, as performed by the computer program BMDO7M (Dixon 1974), presented more questions than answers, and that another avenue of analysis might be more appropriate.

Part of the concomitant sampling of yellowfin involved the collection of gonads for reproductive studies. Much of this material was analyzed by Knudsen (1977a, 1977b). Sharp had proposed to Knudsen that, based on several IATTC length-frequency studies, he believed there were at least two dominant yellowfin reproductive periods annually in the north and central portions of the eastern Pacific fishery and only one in the south. Sharp could not characterize these semestral units by esterase or transferrin frequency groups but he contended that some type of temporal distinction could be shown for different genetically distinguishable components based on the semestral cycling of transferrin gene frequencies which he had observed in the data. Knudsen addressed the questions of temporal and spatial isolation of the two semestral units and concluded that the spawning data collected could not support the hypothesis that separate subpopulations were being maintained by temporal differences in the spawning of X and Y cohorts because spatial isolation of the cohorts did not appear to occur. She based this conclusion on the observation that fish of both cohorts spawned during all times of the year and in all areas of the fishery for which she had data. She was, however, unable to comment further, because the genotypes of the spawning fish which she studied were unknown, and it could not be determined whether separate genetic components were segregating among areas or perhaps returning to specific sites within the areas to spawn.

PGI Analysis 1976-1978

In 1976 a new genetic polymorphic enzyme, phosphoglucose isomerase (PGI), was detected in yellowfin sera. A two-locus, four-allele genetic system was proposed, using blood samples collected from the Gulf of Guinea in the Atlantic Ocean. Inter- and intra-ocean comparisons were made using Atlantic and Pacific Ocean materials. All alleles and phenotypes observed had electrophoretically identical counterparts in both oceans and in all areas. A more complete description of this enzymatic system can be found in the Materials and Methods section of this report. Because this system was polymorphic, and the phenotypic frequencies fit the expectations of an Hardy-Weinberg population, it was decided to reevaluate all of the previously collected blood samples in the hope that this new system might be helpful for subpopulation discrimination.

The PGI A or fast PGI enzyme system proved to be unusually stable, for it was possible to electrophorese and score phenotypes from blood samples that had been repeatedly frozen and thawed over a 7-year period. Regrettably, due to protein overloading and streaking of the protein bands, it was not possible to analyze the "cores and drains" collected from frozen fish in 1973. Reanalysis for the fast PGI system continued until its completion in May 1978. The results of this analysis can be found in the yellowfin data file by fish and sample, and summarized by sample in the yellowfin sample summary (Appendix 6).

Yellowfin Sampling in the Atlantic and Western Pacific

From 1975 to 1978 a number of samples of yellowfin and skipjack bloods and morphometrics were collected from the central, western, and south Pacific. These samples came from Cruises 5001 and 5002 to the Marquesas Islands, exploratory fishing cruises (*Paramount* in 1975, *Mary Elizabeth* and *Zapata Pathfinder* in 1976), and joint collections involving the IATTC and the staff of New Zealand's Fishery Research Division (FRD) and Papua New Guinea's Fisheries Division (FD). The purpose of these collections was to determine the range and the origin of the genetic groups of yellowfin that had been proposed for the eastern Pacific, and to determine if the yellowfin and skipjack of the south and central Pacific belonged to the same exploitable stock as those of the eastern Pacific fishery. For an inter-ocean comparison, a small number of blood samples from Atlantic yellowfin and bigeye, *Thunnus obesus*, were made available to the IATTC. These blood samples were analyzed electrophoretically using the same techniques employed in earlier studies. Esterase, transferrin, and PGI alleles were compared to eastern Pacific material to determine if any unique area-specific alleles or allelic frequencies could be found. No unique alleles were discovered, but variability in allelic frequencies between areas was noted. As was the practice, all phenotypic scorings were recorded on electrophoretic gel records which were arranged in electrophoretic gel notebooks. Many of the starch gels of the Atlantic blood specimens were photographed so that a permanent copy of the scoring procedure and resulting phenotypes are available. These photos can be found with the other electrophoretic gel records in the electophoretic gel notebooks.

Skipjack Sampling

In 1975 a cooperative sampling program with FRD and FD was initiated to evaluate the population structure of skipjack from the western, south, central, and eastern Pacific. A total of 21 samples of blood and morphometrics were collected from different fisheries of the eastern Pacific, and 21 samples of blood and 1 sample of morphometrics were collected from the south and central Pacific. The blood samples were analyzed by the IATTC laboratory for their esterase and transferrin phenotypes, using the standard procedures developed by Fujino and Kang (1968a, 1968b). (The details are given in the Materials and Methods section.) Results of these analyses were to be compared with the work of Fujino, who had analyzed numerous skipjack blood samples from Hawaii, Japan, and the south and western Pacific.

By 1977 the IATTC was no longer involved in the analysis of the south Pacific material, because the South Pacific Commission's (SPC) skipjack survey and assessment group had initiated its own genetic sampling and analysis program. The laboratory analyses were conducted by Dr. Barry Richardson at the Australian National University Research School of Biological Sciences. The IATTC continued to collect and analyze eastern Pacific material and to exchange data with the SPC's project participants until 1978, when it ceased collecting and analyzing blood samples. For further details concerning the analyses performed by the SPC the reader is referred to Anonymous (1980 and 1981).

MATERIALS AND METHODS

Collection of Samples

Fresh blood samples

Whole blood samples of 4 to 5 ml were taken by direct heart puncture with a 1 1/2-inch 18-gauge needle on a heparinized 10-ml Peel-A-Way blood sampler. Each sampler contained 5 ml of a red blood cell preservative (Cushing *et al.* 1957), consisting of a 40:60 mixture of glycerol and a 5% sodium citrate solution. Each sampler was immediately sealed, the contents were thoroughly mixed, and the samplers were placed in a freezer for storage at approximately -10°C (Sharp, 1969). This technique remained essentially the same for all subsequent whole blood samplings with one modification. Beginning in 1970 blood samples were taken as above but no preservative was in the samplers. The samplers were stored in a refrigerator for 4 to 8 hours, after which an equal volume of preservative was added to each, agitated to insure mixing, and frozen as above.

Frozen blood samples ("cores and drains")

Blood samples were taken in 1973 from commercially-caught fish (*i.e.* fish from vessels on which at-sea sampling was not conducted) at the canneries just prior to butchering. The fish were first thawed, and then a boring tool (a laboratory cork borer with a removable plunger) was inserted into the heart region of the fish ("In the isthmus between opercula, in line with the back of the opercula") (Fujino, 1966). The boring tool was removed and approximately 2 ml of the liquid blood were collected in a labeled plastic vial. Care was taken to remove any heart or muscle tissue from these blood samples. The vials were then frozen at -10°C until analyzed.

Labeling of the blood samples

Each of the blood samplers or vials was labeled with a code to designate the sample and either an identification number or the length of the fish. The codes used varied from time to time to accomodate certain aspects of the sampling scheme employed. The following is a general outline of the types of codes used during the different sampling periods.

1) In 1969-1970 the majority of the blood samplers was labeled with a number. Each sample consisted of a sequence of numbers (e.g. 45 to 247). Often the numbers were prefixed by a code letter for a series of numbers (e.g. an X series numbered 1 to 1000, a number only series from 1 to 1000, a (..) series, and an LL series). The corresponding length for each numbered fish was recorded in a green cruise logbook along with the date and location of capture of the fish.

2) From 1970 to 1976 samples of fresh blood, for which morphometric data were not collected, were labeled with a sample code and the length of the fish, usually in centimeters. After the laboratory analysis was completed and the blood samplers were refrozen it was no longer possible to match a phenotype on an electrophoretic gel record to the blood sampler from which it came.

3) For samples of fresh blood collected from 1970 to 1977, for which morphometric data were taken, the first 50 to 52 samplers which had corresponding morphometric data were labeled 1 to 50 or 1 to 52, often with an M preceding the number to designate morphometric samples. The remainder of the blood samplers were labeled with a sample code and the length of the fish in centimeters. The corresponding measurements for the first 50 to 52 samplers were recorded on the morphometric data sheets which can be found in the morphometric notebook. After electrophoretic analysis many of these samples were given G codes based on the locations where the fish were caught. Details on the G codes are given in the section on morphometric sampling.

Yellowfin morphometric samples

Yellowfin external body dimensions were determined using the measurements and calipers described by Marr and Schaefer (1949). Over the years a number of different sets of morphometric measurements have been collected, and the following is a description of the samples, their respective measurements, and how each sample was labeled for analysis. For additional reference five sets of sampling instructions issued to the scientific staff have been included in Appendix 2.

In 1970 it was reported that during Cruise 1054 a series of 11 characters was measured from 76 yellowfin. It was also reported that in an attempt to assess the variability between measurers, a number of these fresh fish were measured independently by two people, and to determine the variability introduced by the freezing-thawing process these fish were measured twice, once when they were caught and again when they were unloaded at the cannery after being frozen in the vessel's hold (Anonymous, 1970). Some of these morphometric data can be found in the morphometric notebook under the tab labeled "Fresh-Frozen." These data were extracted from the original data, and only 6 measurements from approximately 60 fish were recorded. Because the original records of the experiment have been lost the exact number of fish sampled and the number of measurements taken are now unknown.

A program was started in 1970 for the morphometric sampling of the commercial catch. Approximately 50 fish, selected at random, from a single set were sampled from vessels unloading at the canneries. The following nine measurements, described by Marr and Schaefer (1949), were taken from these fish as they were thawing prior to butchering:

1) Total length (TL)
2) Snout to first dorsal (S-1D)
3) Snout to second dorsal (S-2D)
4) Snout to anus (S-A)
5) Snout to ventral (S-V)
6) Head length (HL)
7) First dorsal to second dorsal (1D-2D)
8) Ventral to anus (V-A)
9) First dorsal to anus (1D-A)

Fifteen samples were collected in 1970 and eleven more were added the following year, eight from within the CYRA and three from the area west of the CYRA, but east of 150°W.

A morphometric computer card was punched for each fish; this contained the morphometric data plus the date of capture, the morphometric area (described in Appendix 2), location of capture (using the codes of Shimada and Schaefer, 1956), gear (baitboat or purse-seiner), measurer, and preservation (fresh or frozen fish). Sampling of the commercial catch continued into 1972, but the data for some of those samples have been lost. A listing of the morphometric computer cards, the formats for the data, and some of the initial analysis of the 1970-1971 sampling can be found in a large green computer binder labeled "1970-1971 Morphometrics." In addition, the 1972 morphometric data sheets that are available can be found in the morphometric notebook.

In 1972 Francis and Sharp began a sampling program to collect samples of morphometrics and blood simultaneously. In most cases blood samples were taken from fresh fish at sea. A flag was attached to each fish, and they were frozen in the vessels' wells with the remainder of the catch. Morphometric data were then collected from these fish after they were unloaded at the canneries and while they were thawing prior to butchering. As in previous samplings, nine measurements were recorded for each fish, and infrequently sex was determined. For identification samples with both morphometric and genetic data were assigned a G code for identification. A total of seven samples were collected in the above manner, G150, and G153-G158, and two additional morphometric samples, G151 and G152, were taken from fresh fish. The phenotypic scorings for the fish in these samples can be found in the yellowfin data file and the yellowfin sample summary by referring to the G codes and sample codes in the sample index (Appendix 3). Regrettably, only the morphometric data collected from fresh fish (G151 and 152) are now available, and they can be found in their respective sample folders and in the morphometric notebook. (Additional information on these samples is given by Anonymous (1973).

A total of 16 samples of blood and morphometrics, G200-G215, was collected from the commercial catch in 1973. In contrast to the previous years, both bloods and morphometrics were taken from frozen fish. Each 200-fish sample of bloods and each 50-fish morphometric subsample was to represent a single purse-seine set or baitboat stop. To aid in the identification of these fish NMFS porpoise observers had been equipped with flags to mark large groups of uniformly sized fish. In 1973 two additional samples were collected during Cruises 1070 and 1071. On Cruise 1070, 80 bloods and morphometrics were taken from fresh fish. However, as noted in the green cruise logbook, the fixed part of the calipers had become misaligned so that the accuracy of those measurements was suspect. Seventy fresh fish were sampled for blood and morphometrics on Cruise 1071. This sample is of particular importance because these fish were measured twice, once at sea and again when they were thawed at the cannery.

These data, along with those of Cruise 1059, were used to determine the effect of the freezing-thawing process and to explain some of the variability observed in the morphometric data.

In 1973 only eight morphometric measurements were recorded. The two measurements involving the ventral fin used in earlier studies were eliminated, and the distance from the insertion of the second dorsal fin to the insertion of the anal fin was measured, rather than computed as had been done in the past. This collection of measurements was to remain unchanged for the remainder of the morphometric study. Records of the genetic data collected during this period can be found in the yellowfin sample summary (Appendix 6) by sample and samples can be cross-referenced to their G codes using the sample index (Appendix 3).

The following 56 samples of blood and morphometrics were collected from fresh fish between 1974 and 1976.

<u>Northern area</u>
1974 G (300-302)
1975 G (305-312, 320, and 1 unnumbered sample)
1976 G (313-316, 321)
<u>Central area</u>
1974 G (400-406)
1976 G (420-425)
<u>Ecuador</u>
1974 G (500-510)
1975 G (520-528, 530)
1976 G (531-534)

Morphometric data sheets for these samples are available in the morphometric notebook and copies of the sheets were included in each sample folder. Seven boxes and one metal tray of computer cards employed by Francis in his analyses are also available. The metal tray, labeled "IT 13, Francis, Master file," contains all of the original measurements, and the boxes contain a collection of programs and manipulated data used in his analyses. The morphometrics recorded in the yellowfin data file were taken directly from the morphometric data sheets.

<u>Skipjack morphometric samples</u>

In 1975 and 1976 blood and morphometrics were collected from skipjack using the same techniques employed for yellowfin. The following 17 samples were collected in the eastern Pacific:

<u>Northern area</u>
KA, KB, MK A1, MK A2, MK C, MK D, TAR B1, TAR G2
<u>Central area</u>
SC SG
<u>Ecuador</u>
ECB, ECC, ECD, ECE, ECF, ECG, ECH, ECI

Only three samples of skipjack morphometrics (PNG NH, S218, and S223) were collected from the south Pacific. The first sample was taken from 40 fish near Papua New Guinea, and the other two came from the inshore waters off New Zealand. In all cases the same eight characters used in the yellowfin study were measured.

Laboratory Analysis

Between 1969 and 1978 the following people were involved in the analysis of blood and tissue samples at the IATTC laboratory.

Scientist in charge:
1969-1978 Gary Sharp

Laboratory assistants:
1970 Dorothy Normark
1970-1971 James Cravens
1971-1973 John De Beer
1973-1974 Robert Olson
1974-1975 Suellen Pirages
1975 Deborah Jo Czapinski
1975-1978 William Kane

For the esterase and transferrin analyses, each person was instructed by Sharp in sample preparation, electrophoretic techniques, and staining procedures. Except for Suellen Pirages and William Kane, the other assistants were initially unfamiliar with electrophoretic procedures.

The electrophoretic gels were prepared in two groups per day, usually by Sharp prior to 1975 and by Kane thereafter. The resulting phenotypes were scored either by Sharp or by the experienced assistants (Pirages and Kane). Many of the gels analyzed by Sharp and Pirages and most of the pre-1976 analyses of Sharp and Kane were checked for reading errors. First one person would read the gels and record the phenotypes. Then the other person would read the same gel (without referring to the previous reading) and compare his scores to the ones that had been recorded. The blood samples with scoring discrepancies were reanalyzed, and questionable scores in the gel records were marked with the symbol "RR." These blood samples were reanalyzed until a satisfactory scoring was possible, or the blood sample was deemed unscorable. A blood sample was usually considered unscorable when enzyme breakdown products (satellite bands or excessive streaking) were observed upon repeated analysis. Serum enzyme breakdown was commonly due to the contamination of a blood sample by stomach fluids resulting from inserting the needle too deeply when the blood sample was taken, improper storage, or heating of the blood samples during transit from the collection site to the laboratory. In addition, due to inconsistent handling of the materials and techniques by some of the inexperienced assistants, or to obvious technical problems, an entire gel or series of gels were marked with an "RR" and later reanalyzed.

The following is a general outline of how the blood and tissue samples were analyzed:

For electrophoretic analysis the blood samples in vials or samplers were arrayed while thawing in racks by 1) numerical order, 2) numerical order for the morphometric fish and length for the remainder, or 3) length. For fresh blood samples, aliquots of each sampler were dispensed onto a plastic plate having 100 depressions in a 10 X 10 array. Whatman No.3 filter paper wicks (3 X 5 mm.) were then placed in the depressions, or into the vials in the case of frozen blood samples, until they were saturated. The excess was removed by blotting on filter paper, and the wicks were placed in the previously prepared gel. (For diffuse blood samples which had been overdiluted with preservative the proteins were reconcentrated using Sephadex granules to absorb the excess liquid.)

Initially (Dec. 1969-Feb. 1970) the micro starch gel method of Tsuyuki, et al. (1966) was used to separate the proteins electrophoretically. The zones of activity for each enzyme were determined by using a specific histochemical stain or, in the case of transferrins, by the autoradiographic technique of Barrett and Tsuyuki (1967). In March 1970, after conferring with Dr. Fujino, Sharp adapted a "modified" Fujino method for the separation of proteins because it gave improved resolution over the micro starch gel technique. Also adopted at this time was an amido black staining procedure to replace the autoradiographic method for assaying for transferrins. With this staining procedure it was possible to perform a double-staining process. After completion of the protein separation the gels were first stained for serum esterases using alpha-napthyl propionate and alpha-napthyl acetate as substrates and scored for the resulting phenotypes in 10 minutes. After recording the esterase phenotypes the gel could then be stained with an amido black solution for transferrins. This double-staining process did not affect the resolution of either of the two enzyme systems. A list of stains and buffers with references is given in Sharp (1972: Addendum 1) (Appendix 1 of this report).

The electrophoretic gels used to evaluate the phosphoglucose isomerase (PGI) phenotypes were made using 35.0 g starch (Connaught Laboratories, Inc.) in 330 ml 0.0025 M Tris-citrate pH 8.00 gel buffer. This volume was sufficient to fill two gel molds of approximately 21.5 x 14 x 0.6 cm. Fifteen whole blood samples were then applied to each gel via Whatman No. 3 filter paper wicks. A discontinuous buffer system was employed to process the gels. The cathodal chamber was filled with 2 l of a 0.05 M Tris solution buffered to pH 8.0 with 0.05 M citric acid. The anodal chamber contained 0.3 M borate and 0.06 M NaOH at pH 8.0. A current of 50 ma was maintained across each gel for 4 hrs by periodically adjusting the voltage (ranging from 160 to 200 V). To maintain an even temperature electrophoresis was performed in a refrigerator set at approximately 4°C.

The gels were stained for PGI activity by applying a wash of 0.01 M Tris-HCl pH 8.0 containing 50 mg of the substrate fructose-6-phosphate, 100 units of the coenzyme glucose-6-phosphate dehydrogenase, 20 mg NADP, 40 mg nitro blue tetrazolium (NBT), 20 mg thiozolyl blue (MTT), and 10 mg phenazine methasulfate (PMS). The gels were then incubated at approximately 40°C for 20 minutes and scored for the fast PGI (A) phenotypes. To enhance the resolution of the slow PGI (B) bands many of the gels were incubated overnight (approximately 12 hours). But even given the longer incubation time, PGI (B) phenotypes were not resolvable in most gels.

Description of the Enzyme Systems

Esterase

Nonspecific serum esterases for yellowfin, skipjack, albacore, *Thunnus alalunga*, and bigeye were first characterized by Fujino and Kang (1968a). Six esterase bands were recognized in skipjack, three in albacore, and two each in bigeye and yellowfin. The relative mobilities of these bands were described in two figures and, based upon the standard Hardy-Weinberg analysis, the bands were assumed to represent codominant genes of multiple-allele esterase genetic systems. With the data available it was possible to test the skipjack allele frequencies for sex and size relationships (none were found), but insufficient data were available to perform these tests on yellowfin, albacore, or bigeye.

The IATTC electrophoretic techniques and scoring systems for yellowfin, bigeye, and skipjack were adapted from those of Fujino with slight modifications. For yellowfin and bigeye the serum esterases were labeled such that the most rapidly migrating common allele was given the lowest value (EST 1) and slower-migrating products higher values (EST 2 and EST 3). A rare, rapidly migrating allele which was encountered after the numbering system had been adopted was labeled EST 4.

Skipjack esterases were labeled in a similar manner, resulting in Fujino's E 1sj, E 2sj, and E 3sj being renamed EST 2, EST 3, and EST 4 respectively. EST 1, the fastest-migrating esterase product, was not encountered by Fujino in his early studies. Faint or otherwise unclear phenotypes were re-electrophoresed with samples of known phenotypes and restained. This process was repeated as many as four times, until either a clear, easily scored result was obtained or the serum sample was considered unscorable.

Transferrin

Barrett and Tsuyuki (1967) were the first to describe polymorphic serum transferrins for scombrid fishes. Yellowfin, skipjack, bluefin, Thunnus thynnus, albacore, and bonito, Sarda chiliensis, sera from various areas of the eastern Pacific were analyzed using a micro starch gel electrophoretic technique followed by an autoradiographic process to detect transferrin activity. Genetic control of the banding patterns observed was assumed, based upon an analysis of the frequency of the observed phenotypes and the expected values for a population in Hardy-Weinberg equilibrium. A combination of two bands resulting in three phenotypes was reported for yellowfin and bonito. Six phenotypes were used to describe a codominant three-allele system for skipjack and albacore. Bluefin transferrins did not show any allelic variation.

In 1968 Fujino and Kang (1968b), using horizontal starch gels and an amido black staining procedure, described polymorphic transferrins in three species, skipjack, yellowfin, and southern bluefin, Thunnus maccoyii, from the Atlantic and Pacific Oceans. As in the earlier work of Barrett and Tsuyuki, six phenotypes were observed in skipjack sera. The numbering system and the amido black staining procedure were adopted, for the IATTC laboratory, with the addition of a rare, slowly migrating allele TFN 4. Fujino and Kang were also able to test the skipjack transferrin system for independence, and found no relationship between the TFN phenotypes, the esterase phenotypes, and the sex or size of the fish.

Fujino and Kang (1968b), in their study of yellowfin transferrins, adopted the lettering nomenclature of Barrett and Tsuyuki. The fast-migrating band was labeled "A" and the slow-migrating band "B." In addition to the previously described alleles, Fujino recognized a faint band that migrated faster than the "A" allele and labeled this "a." This gave a total of five phenotypes for yellowfin. As in earlier studies, a comparison of Hardy-Weinberg equilibrium frequencies was used to verify a codominant autosomal allelic interpretation of the observed banding patterns. Fujino also reported at that time that the yellowfin transferrins were independent of the esterase system, and the size or the sex of the fish. Although the same electrophoretic and staining procedures employed by Fujino were used at the IATTC, no "a" alleles were encountered. As a result, the "a" allele was not included in the nomenclature used at the IATTC. The relative mobilities of the yellowfin and skipjack transferrins are shown in Figure 1.

Phosphoglucose isomerase

In late January 1976, 26 serum samples each from yellowfin, skipjack, wahoo, *Acanthocybium solandri*, and black skipjack were electrophoresed using a standard Ashton buffer. This buffer system, described by Sharp (1972: Addendum 1)(Appendix 1 of this report), was routinely used to assay for esterase and transferrin activity. The resulting gels were histochemically stained for esterase, transferrin, glutamate-oxaloacetate-transaminase (GOT), and phosphoglucose isomerase (PGI). Esterase and transferrin bands were easily assayed under these conditions, giving a collection of bands for yellowfin, skipjack, wahoo, and black skipjack. The Ashton buffer did not provide good separation of the GOT enzyme system, although some multiple banding was noted. In the case of PGI, the separation was good, but distinct bands were not formed. Changing the buffer system to Tris-citrate pH 8.0 (labeled "LDH" in the electrophoretic gel records) improved the PGI resolution dramatically, and a polymorphic PGI enzyme system for yellowfin and bigeye was described in February 1976. A total of 294 yellowfin and 63 bigeye blood samples collected in the Atlantic Ocean were used for this survey. Photographs of the gels used in the survey are available in an envelope in the electrophoretic gel notebook for 1976.

Upon staining the following zones of PGI activity were noted: (1) a strongly staining fast-migrating group of bands, later designated the PGI (A) system; (2) a broad area from the origin up to the fast-migrating system where activity was observed but no distinct bands or patterns could be discerned; and (3) an area of cathodally migrating bands where activity in yellowfin was sporadic. (In yellowfin only two bands were observed in 26 samples, compared to skipjack which had distinct cathodal bands. Photographs of these gels are available in the electrophoretic gel record attached to the page for January 29, 1976. Initially a lettering system was used to describe the phenotypes observed. This nomenclature was soon abandoned in favor of a numbering system, so that scores for transferrins and PGI could be easily differentiated. Details on the relative mobilities and the nomenclature employed are shown in Figure 2 for yellowfin and bigeye and Figure 3 for skipjack.

Agreement with Hardy-Weinberg equilibrium frequencies was used to verify that the PGI (A) system was genetic in nature. Samples from different regions of the eastern Pacific were then analyzed and compared to each other and to the Atlantic material. In a G test of the allelic frequencies of different areas of the Pacific it appeared that inter-area gene frequencies were statistically different. At this point it was decided to reanalyze all previously collected yellowfin blood samples for the PGI (A) system, in the hope that they would be useful for subpopulation discrimination.

Resolution of the diffuse area below the fast-PGI bands did not improve with a change in buffers, and for many blood samples enzymatic activity in that area was negligible. It was hypothesized that this activity was due to some form of tissue-specific PGI, and because it was only marginally resolvable in whole blood it was not considered usable at that time.

In May 1976, tissue surveys for PGI were conducted on 14 species using frozen red, white, and heart muscle tissue. These tissue samples had been collected over a period of years, and many were showing signs of deterioration due to storage. The PGI (A) enzyme system was detectable in all three tissues, but showed the greatest activity in the heart muscle tissue. This observation was true for skipjack, albacore, bluefin, wahoo, sierra, _Scomberomorus sierra_, frigate tuna, _Auxis thazard_, black skipjack, and yellowfin. Many of the gels used in this survey were photographed; a permanent record is available in a folder in the 1976 electrophoretic gel notebook. The slower-migrating PGI activity noted earlier was either very faint or in most cases totally absent in these gels.

In order to determine if there were any low-level polymorphisms in skipjack and to check that nothing had been overlooked in the earlier survey, 51 skipjack blood samples were analyzed for fast PGI in April 1976. Twenty-six of these blood samples were from New Zealand and 25 from the eastern Pacific. Only one of the New Zealand blood samples was electrophoretically distinct. This specimen displayed a typical three-banded heterozygous pattern. Otherwise, the PGI electrophoretic bands were identical for both areas.

In April 1977, during routine analysis for the PGI (A) system, it was noted that in some of the recently acquired yellowfin samples from the south Pacific the slower-migrating activity of the gel could be resolved into distinct bands. From April 1977 until the end of the study approximately 430 yellowfin blood samples were scored for both fast and slow PGI systems. Because of the sporadic nature of the slow PGI system, it was not possible to test this system of bands adequately for its genetic nature or linkage to the PGI (A) system. Based upon a recent review of the PGI literature, it is now believed that the slow PGI system may not be independent of the fast system, and may be a collection of heterodimeric bands of a fast PGI muscle system and a slow PGI liver system. This type of condition has been observed in many teleosts (Avise _et al._ 1973; Dando 1974; Allendorf and Utter 1979). This hypothesis could be tested by analyzing a number of fresh tissue samples (e.g. white, red, and heart muscle, liver, pyloric caeca, sera, eye lens, and red blood cells) for specific PGI activity. Eye lens tissue in particular would be a good tissue to study because a polymorphic slow (liver-type) PGI system from the eye lens of albacore was recently described using techniques similar to the ones employed here (Dr. John Graves, personal communication).

A total of approximately 18,000 yellowfin blood samples was analyzed for the fast PGI enzyme system. Where possible, these data have been cross referenced to individual fish. The PGI phenotypic scores were recorded in columns 45 and 46 in the yellowfin data file and were used to compile the yellowfin sample summary (Appendix 6). For many of the blood samples collected before 1975 it is impossible to match blood samples to individual fish. Consequently, a separate listing of PGI phenotypic scores and associated lengths are supplied in the yellowfin data file. Because of the questionable nature of the slow PGI system, these data were not included in this data report. However, a separate folder labeled "PGI data (slow)" in the PGI workup and photographs notebook contains copies of all the electrophoretic gel records for the slow system plus some photographs.

Approximately 144 skipjack were analyzed and scored for the PGI (A) enzyme system, 26 from New Zealand, 25 from the eastern Pacific, and the remainder from the Marquesas Islands. The phenotypic distribution was 132 "2-2," 6 "2-3," 3

"1-2," and 3 unscorable. Of the total, only 15 of the Marquesas blood samples were scorable for the hypothesized slow-PGI (B) system. Eleven were homozygous slow "SS," two homozygous fast "FF," and two were heterozygous "FS." As is true for yellowfin, the exact genetic nature of this group of bands is unknown, and more work must be conducted to determine their usefulness. It should also be noted that skipjack blood possesses a strong cathodally migrating group of PGI bands, and this area also deserves further attention.

Recently Fujino, Sasaki, and Okumura (1981) described a PGI enzymatic system found in whole skipjack blood and the hemolysate of red blood cells. Using a Tris-citrate pH 5.8 buffer, nine phenotypes were observed, formed from nine anodally migrating bands, the most common being PGI 6, with a frequency greater than 0.970. No mention is made of any cathodally migrating bands in either the text or the accompanying diagrams. The apparent differences between this system and the one described here may be due to the different pH values employed, 5.8 for Fujino and 8.0 in this study.

Sixteen bigeye blood samples from Papua New Guinea and 63 from the Atlantic Ocean were analyzed for PGI. Only fast-migrating PGI (A) bands were discernable, and the corresponding alleles were indistinguishable from those of the yellowfin PGI (A) system.

Tissue Surveys

Samples of heart muscle, white and red lateral muscle, and liver were excised from fresh and frozen fish and placed in individual Whirl-Pak bags, labeled, and stored at -20°C. In many cases tissues were stored for as long as 4 years before being analyzed. To prepare tissue samples for analysis, small segments of approximately 1 g were homogenized in either 0.1 M phosphate and glycerol solution (60:40) pH 7.0 or a distilled water and glycerol (60:40) solution. A motorized ground glass mortar and pestle in ice was used for homogenization. The samples were then centrifuged at 200 g for 10 minutes. Supernatants were collected by pipettes and stored at -20°C.

A number of tissue surveys were conducted at the IATTC laboratory. In 1969 and 1970 Sharp employed the Tsuyuki micro starch gel technique to separate proteins. He then histochemically stained these gels in the original survey for possible polymorphic yellowfin enzymes. In 1970 and 1973 Sharp performed additional tissue surveys using the horizontal starch gel techniques of Fujino. The following notebooks are available to describe the analyses performed: 1) "Esterase and transferrin early records December 1969-June 1970," 2) "Esterase and transferrin scoring records, tissue survey, photographs of standards, March-April 1971," and 3) "Cetacea and yellowfin enzymes 1971-1973." Poloroid photographs of many of the gels are available, either attached to the notebooks or at random in a box marked "photos."

In 1973 Sharp conducted an electrophoretic survey of 20 yellowfin, 40 to 44 cm in length, from a single school to measure the amount of intra-school genetic variability. Blood, heart muscle, liver, white and red lateral muscle, and eye tissue were sampled from each fish and analyzed for esterase, transferrins and 14 other enzyme-protein systems. The results of this survey were reported in Table 7 of Anonymous (1974). Records of the gels can be found in the electrophoretic gel notebook for December 6, 1973, to January 8, 1974.

Sharp and Pirages (1978) performed a number of tissue surveys in 1974-1975. They surveyed 14 species for polymorphisms using a number of enzymes, the standard horizontal starch gels of Fujino, and the staining recipes of Shaw and Prasad (1970). Records of the gels used for this study can be found in the 1974 electrophoretic gel notebook. Many of the gels were photographed and can be found as figures in that paper or in the box marked "photos."

A small number of tissue surveys were conducted by Sharp and Kane from 1975 to 1978. The electrophoretic gel records and photographs of the gels can be found in the electophoretic gel notebooks for those years and in the notebook marked "PGI work up and photos."

DATA

Sources of Data

At the outset of this project there was no reliable source of information on the electrophoretic analyses that had been performed at the IATTC. The data which were available were in the form of published and unpublished reports and sample summaries, none of which represented all of the data. In order to eliminate any transcription errors that, over the years, may have been incorporated into the data and to be as complete as possible the original electrophoretic gel records have been used in this report to compile the data files and produce the sample summaries. There are four principal sources of data available at this time, 1) green cruise logbooks, 2) bridge logbook abstracts (described below), 3) morphometric data sheets, and 4) electrophoretic gel records. The quantity and quality of information available from each of these sources varies due to the large number of people involved in the collection and analysis of the data. Consequently, it was necessary to check all entries to insure their accuracy. The following is a detailed description of the data and how they were used to compile the yellowfin and skipjack data files.

Green cruise logbooks:

Green cruise logbooks were kept by the scientific staff aboard each chartered tagging vessel. These logbooks were designed to be a daily record of all fishing and scientific activities, but because there was no set format for logbook entries the amount of data recorded varied considerably, depending on who was responsible for keeping the logbook. For this report logbooks were used to supply details on dates, locations, and size composition of the samples. Additionally, some of the early (1969-1971) logbooks were employed as a source of raw data (usually lengths for numbered samplers). The green cruise logbooks, identified by cruise number, are stored at the IATTC headquarters with the tagging records.

Bridge logbook abstracts:

When discrepencies in sample dates and locations were noted between the published records and green cruise logbook data, the bridge logbook extracts were consulted to check the information. Bridge logbooks are kept by the navigator of each vessel, and abstacts of these logbooks are made by the IATTC staff at the end of each fishing trip so that catch and effort statistics may be computed. The bridge logbook abstracts, which are confidential, are stored at the IATTC headquarters with the statistical records.

Morphometric data sheets:

Several different formats were used to record the morphometric data.

1) Initially forms consisting of 6 to 9 columns and 50 rows were constructed by the person sampling. There was no particular order for the columns, so that one must note the column headings in each case.

2) Starting in 1972 a form entitled "Field Data Sheet-Tuna Morphometrics" was employed to record data. Nine measurements were recorded for each fish, along with information on the morphometric area (described in Appendix 2), location of capture (using the codes of Shimada and Schaefer, 1956), gear, measurer, preservation, and infrequently sex. This form was constructed to allow key punching of the data directly from the sheets.

3) From 1973 onward, a new form entitled "Morphometric Sample Sheet" was used. Eight measurements were recorded, as well as flag number (or fish number), measurer, vessel, location and date of capture, and location and date sampled. Later, G codes and location of capture codes were added to the top of each form. In the 1973 samples it is common to see the esterase and transferrin scores written in the far right column of each morphometric sheet.

All of the original morphometric data now available are contained in a large black looseleaf binder marked "Morphometric Sheets." Photocopies of the morphometric data sheets used to create the data files can also be found in each sample folder. It should be noted that from 1970 to 1973 many morphometric samples were taken that were not associated with genetic samples. Many of these samples were collected in port on frozen fish, and have since been lost. The samples that are available can be found in the morphometric notebook.

Electrophoretic gel records:

1) From the initiation of sampling in 1969 until December 1970, 400 blood samples were analyzed and summary sheets were made from the electrophoretic gel records. Only an incomplete set of the original electrophoretic gel records is now available, so a collection of summary sheets prepared by Sharp was used as a source of data for these samples.

2) From December 1970 till February 1971 the electrophoretic gel records were recorded in random order on looseleaf pages. From these pages a collection of summary sheets (8 1/2 by 14-inch yellow paper) were transcribed by Sharp. Later, the data on the summary sheets were used for key punching the 1971 computer cards. For the yellowfin data file the loose-leaf data were matched to the lengths recorded in the green cruise logbooks. These summary sheets can be found in the Marietta 1970 sample folder.

3) A brown folder entitled "Esterase and Transferrin Scoring Records" contains photographs of the gels containing enzyme standards and records of the blood samples analyzed from March to June 1971. The records of the second analysis of the original 400 blood samples collected in 1969 and some of the early tissue surveys can also be found there.

In 1972 all of the existing genetic data were computerized. Although it is impossible to match all of the computer cards to individual fish, most of these data were key punched in the same order as they appeared in the electrophoretic gel record sheets. As a result, it is possible to compare some of the phenotypic scores recorded in the electrophoretic gel records with the data recorded on the computer cards.

After the yellowfin data file was compiled from the original electrophoretic gel records, this information was compared to a 1972 computer printout of the computer cards. When scorings in these two sources did not match, the original documentation was rechecked and any discrepencies were noted on the computer printouts that can be found in the sample folders for these samples.

4) From June 1971 until 1978 the electrophoretic gel records were recorded on daily work sheets. These work sheets are arranged by year in four black looseleaf binders (electrophoretic gel notebooks). These electrophoretic gel records were used by Sharp to create summary sheets that described the phenotypic frequency distribution of each sample by 1-cm length groups. Each summary sheet was divided into length groups to analyze the shifts in gene frequencies as a function of length. During this analysis Sharp removed fish with lengths in the extreme tail ends of the length distribution to make the samples more size homogeneous. Once removed, these fish were not considered in any future analyses.

5) A separate folder was used to record the details of the early PGI analysis. This notebook, labeled "PGI Work Up and Photos," contains photographs of all the gels used to define that genetic system.

<u>Construction of the Data Files</u>

The following is a list of the steps employed in preparing the data files.

1) For quick reference a 3- by 5-inch index card was created for each sample containing information collected from, published and unpublished reports, manuscripts and green cruise logbooks. These cards were used as a reference only, and were not intended as a summary of all the information available for a sample.

2) The electrophoretic gel records were then photocopied, and the photocopies were cut up, sorted into their respective samples, and placed into the appropriate sample folders.

3) Data for each sample were arranged on formatted sheets for key punching. (The key-punch sheets are available in each sample folder.) In instances where the blood samples were numbered in the electrophoretic gel records but the blood samples were not analyzed in numerical order, the photocopies were put into numerical order before key punching.

4) A listing of the new computer cards was made and checked for accuracy against the original documentation.

5) The new computer cards were read into files on computer discs, (14 files for yellowfin and 3 files for skipjack).

6) Key-punching errors were corrected in a two-step process. First, the data for each fish was punched on a card, and then the cards were repunched to verify the information. When errors involved only a small number of cards new cards were punched. When errors involved a large number of cards these errors were corrected on the computer disc. When corrections were made on the computer disc the corresponding computer cards were not repunched. Consequently, the computer cards at that point were no longer an accurate record of the data.

7) The data on the disc were rechecked for errors, primarily spacing errors, and changes were made to some of the codes used for sample identification. Most of these changes involved vessel type, and were made so that the skipjack and yellowfin codes were compatible.

8) The 14 yellowfin and 3 skipjack files were condensed into two large data files.

9) The two large data files were indexed by sample code for faster retrieval and used to print copies of the data and to create the sample summaries (Appendices 6 and 7).

Organization of the Data files

The yellowfin and skipjack data files are listings of the data associated with each blood sample. To aid in the identification of samples, two sample indices (Appendices 3 and 4) have been included as cross-reference keys. Through the use of these indices each sample code can be matched to the vessel, cruise number, and date and location of the collection. Also included in the sample indices are the dates on which samples were analyzed electrophoretically, the approximate number of blood samples collected, and the G codes. This was done so that a person can reference the original data in one of the electrophoretic gel notebooks.

The genetic, morphometric, and sample collection data for each fish have been coded so that they can be accessed using a computer routine. A key as to how the information was coded is included at the end of this section. Except for blood samples which were analyzed more than once, each entry in a data file represents one fish. Many of the pre-1976 blood samples have two sets of data. This is a consequence of the way each blood sampler was marked when it was collected. The first set of data includes sample collection information, morphometric data, and the results of the esterase, transferrin, and PGI analyses for any fish that was used for morphometric studies. The second set of data contains sample collection data and the results of the PGI analysis for the remainder of the fish in the sample. The first 50 fish in a sample were often used as a source of morphometric data, so each sampler was assigned a unique number. Using these numbers, it was possible to match the morphometric samples with their corresponding esterase, transferrin, and PGI phenotypes when compiling the yellowfin data files. The second sample set usually starts at fish number 51 and continues to fish number 200. These samplers were marked with a sample code and a length, and when the PGI analysis was performed it was impossible to match these samplers and their phenotypic scores with the phenotypic scores of the earlier esterase and transferrin analysis. Consequently, for some of the yellowfin samples in the data file, there are two sets of data with fish numbered from 51 to 200. The first set has esterase and transferrin data, the second has PGI data, and the fish numbers and fork lengths in one set do not correspond to those in the other. Samples arriving at the laboratory after the PGI system was described were analyzed simultaneously for esterase, transferrin, and PGI. There is only one set of data for each of these samples, and it contains information on all of the enzymatic systems. Thus the problem is only with those samples that had to be reanalyzed for PGI after this polymorphic enzyme system was discovered in February 1976. These samples can be identified using the date of analysis found in the sample index.

In order to check that the blood samples analyzed for PGI were correctly matched to the esterase and transferrin data, any questionable samples were sorted by length and the number of fish in each length category in each analysis was compared. Several discrepencies were noted in 1971 samples (Sample MP I is a good example). These inconsistencies are believed due to a change in the way some of the lengths were rounded when millimeters were converted to centimeters. In 1971 some of the samples were rounded down (e.g. 75-cm fish were fish with lengths from 750 to 759 mm.). In 1975 and later analyses all millimeter records were rounded so that 75-cm fish would represent fish having lengths from 745 to 754 mm. In this report lengths have been recorded in millimeters whenever possible to eliminate rounding problems.

In many samples the number of fish scored for esterase, transferrin, and PGI phenotypes are not identical. This is due to 1)samples being scorable for only one or two of the systems, 2) blood samples being removed after the esterase and transferrin analyses to a collection of "standards" if unusual phenotypes were evident, or 3) blood samples becoming either lost or unidentifiable after freezer storage.

A number of the yellowfin and skipjack samples are represented twice in the data files and sample summaries. This is due to these samples having been analyzed on more than one occasion for the same enzyme system(s). The following is a description of these duplicate samples and the details pertaining to their analyses.

1) In Sharp (1972) five samples are used as examples of the stability and reproducibility of the esterase and transferrin systems. In this report Sharp stated that the original 400 blood samples were reanalyzed two years after collection and found to be invariant, i.e. no time dependent loss of resolution was observed. Both the initial analyses of 1970 and the reanalyses of 1971 have been included in this report. The scoring records of the 1970 analyses are labeled CNJ A1, MRC B1, MRC C1, CNJ D1, and CNJ E1, and the phenotypic scores assigned in the 1971 reanalyses are labeled CNJ A2, MRC B2, MRC C2, CNJ D2, and CNJ E2, respectively. In both cases the modified Fujino technique was employed to separate the proteins, and many of the individual blood samples were analyzed and then reanalyzed on different days and on different gels when initial scorings were questionable. These scores were not considered to be "altered scores" by the investigator because the resulting phenotypic scores were used in a number of reports. (The summarized 1970 esterase scores were described in the IATTC May-June 1970 bi-monthly report and versions of the 1971 esterase and transferrin analyses were reported in Sharp, 1972).

It should be noted that only an incomplete set of the original 1970 scorings is available. Consequently, it was necessary to abstract some of these data from summary sheets created by Sharp from the original electrophoretic gel records. It is also important to note that early in 1970 Sharp reported having reproducibility problems with the esterase system (IATTC March-April 1970 bi-monthly report). These problems were reported solved by consulting with Dr. Fujino, however, and the results of the esterase analysis were reported in the IATTC May-June 1970 bi-monthly report. These esterase scores and their associated transferrin scores were used for the 1970 scorings in the yellowfin data.

If a comparison is made between the esterase and transferrin phenotypes recorded for the 1970 and 1971 analyses, several discrepencies are evident. Of the approximately 400 fish used in these analyses, a total of 46 esterase and transferrin scores do not coincide in both analyses, and 17 of the fish that were scorable in 1970 were no longer scorable, either for esterase or transferrin, in 1971. It is not known why there are disparate scores in these two analyses when the two analyses had been reported to be invariant.

Sharp (personal communication, 1983) has responded to these statements saying that, "Anyone trying to work with the data from 1969 through 1970 would have to have been there to follow the series of minor numbering shifts that occurred in the samples, or in the ordering for the analysis in order to sort out how these were juggled in order to arrive at the phenotypes. The original series were often mis-queued. There are several ways in which the tables and numbers on samples could and did get mixed up by lot and series. The moment of application of the sample numbers in the early samples was confused by having four or more people involved in the sampling, and often either numbers were duplicated or poorly written on the sample vials, ..., These samples were used in only setting up the systems employed."

It is possible that the 1971 analysis produced better resolution, or the person analyzing the gels was more confident of the scoring procedure after consulting with Fujino. But whatever the cause of the disparity, the 1970 and 1971 analyses are not good examples of protein stability or the scoring reliability of the esterase and transferrin systems.

2) The only example of the reanalysis of a yellowfin sample for the esterase and transferrin systems involving a large time interval (approximately 5 1/2 years) is the <u>Gemini</u> K samples. Sample GEM K1 was analyzed and scored by Sharp in September 1972. The same group of blood samples was reanalyzed by Kane for esterase and transferrin activity in March 1978 and for PGI activity in February 1978. The 1978 analysis was later labeled GEM K2 to distinguish it from the initial analysis. Neither of these two analyses is well suited for determining scoring reliability because many of the blood samples have no corresponding lengths and the samplers were not numbered individually so that one can not compare scorings for individual blood samples. However, if each analysis is taken as a whole, there is a considerable difference between the number of transferrin "AA" and "AB" phenotypes and a smaller difference in the number of esterase phenotypes recorded for these analyses. In the early transferrin analysis there were 117 "AA," 69 "AB," and 14 "BB," and in the early esterase analysis there are 9 "12" and 2 "13." In the 1978 analyses there are 104 "AA," 83 "AB," 13 "BB," 11 "12," and 2 "13" recorded. The disparity in the scores could be due to simple reading errors or to some combination of protein degradation and subsequent reading errors. It is possible that after repeated freezings and thawings and long storage the single banded "AA" transferrin phenotype may have become fuzzy due to the presence of breakdown products. This fuzzy banding pattern could then be mistaken for the heterozygous "AB" phenotype. Whatever the reason for the disparity, these two analyses raise some

questions about the reproducibility and stability of the esterase and transferrin systems as they have been analyzed here.

In reference to the Gemini K samples and the apparent dissimilarity in the analyses, Sharp (personal communication, 1983) commented that, " The entire Gemini K sample series was confused because of tape recorder failure and sample tube marking problems. Besides that the fish sizes were variable, hence of little value to anyone looking at the data beyond its original intent - to see if Non-CYRA material differed distinctly from CYRA samples. It did not, except the fish tended to be bigger and mixed sized."

3) In the skipjack sample summaries and data files three Taurus samples (Cruise 1075) have been duplicated. Samples Taur B, Taur G, and Taur G2 were analyzed and scored in September 1975 by Sharp and Czapinski. This was the first large skipjack sample analyzed at the IATTC, and there is no record of how the banding patterns were scored. Sharp (personal communication, 1982) has commented that: "The numbering system used was the fastest to slowest esterase bands and were numbered 1, 2, and 3 respectively. As only one fast band was observed as a heterozygote, no 'standard' was available to evaluate these against Fujino's labels. Later, after analyzing several samples from various locations in the Pacific, and discovering the fourth allele, the labeling of the Taurus samples was changed to conform to the described labeling system." If the above were accurate, then the Taurus samples should have been renumbered to coincide with the scoring procedure reported here by increasing all the previously assigned allele numbers by 1. Thus allele 1 would become 2, 2 would become 3, and 3 would become 4 to make room for the newly discovered fast allele which would be labeled 1. However, this is not the case. In Sharp's summary sheets for these samples the esterase alleles 1, 2, and 3 that were first recorded have been changed to 4, 3, and 2, respectively. An additional allele labeled 1 was added, but was not observed in these samples. The same kind of transformation was applied to the transferrin alleles. Transferrin allele 2 was relabeled 3, allele 3 was relabeled 2, and no transferrin 1 alleles were observed in these samples. In the skipjack sample summaries and data file the scorings of the 1975 analysis have been recorded and labeled TAUR B, TAUR G, and TAUR G2. The transformed scores used in subsequent publications (transformed using the procedure outlined in Sharp's summary sheets) are labeled TAUR B1, TAUR G1, and TAUR G3, respectively.

There are two examples where the validity of these transformations may be scrutinized.

A) Sample TAUR B was first analyzed on September 2, 1975, and either Sharp read the gels or he checked the scoring records of the gels. On January 8, 1976, eight of the blood samples from TAUR B were reanalyzed and scored by both Sharp and Kane. With one exception (B34 was first recorded as a 22, was transformed to a 33, and then was recorded as a 22 on January 8) the transformation of the September 2 transferrin phenotypes matches those recorded for January 8. With the esterase scores there are two blood samples where the transformed scores do not coincide with the January 8 analysis. Fish B34 and B38 are both listed as esterase 12 in the original scoring. This scoring would normally be transformed to a 34 phenotype, but on January 8 these two blood samples were scored as 23.

B) TAUR G is a sample of 21 fish. This sample was first analyzed on September 4, 1975, and then fish 1, 2, 6, 10, 11, and 21 were reanalyzed and scored by Sharp on September 5, 9, and 22. These blood samples were reanalyzed by Sharp and Kane on January 6 and 8, 1976. It should be noted that the scoring procedure employed on January 6 and 8 is the same procedure or labeling of phenotypes shown in Figure 1 and used for the majority of the skipjack samples analyzed. The phenotypes of these samples and the transformed phenotypes are depicted in Table 1. The transformed scores of the transferrin analyses are consistent with the January analyses with one exception. Fish 6 was recorded as a 11 on September 4, and there is no precedent for transforming this score. For the esterase system there is no consistent way to transform the scores to coincide with the January scorings. Also, some of the samples scored on September 4 and 5 do not coincide with the scores recorded for September 9 and 22. These two sets of scores should be the same if the phenotypes were scored consistently.

When the inconsistencies in the data were brought to Sharp's attention he responded (personal communication, 1983) saying, "The Taurus samples (skipjack) were analyzed without reference standards and were only originally scored to see if we could achieve the resolution needed to do the comparative studies which came after." "Rescoring a 3-4 as a 2-3 or the original 1-2 as a 2-3, or a single band 2-2 as a 3-3 during the first few scoring sessions was not novel or unexpected. That is why we reran them time and again - to get consensus for the long series to be run later. I doubt that we had really settled on the scoring system by 8 January 1976, as we were just getting started through the samples of skipjack from PNG, the October '75 cruises."

The following comments of Sharp (personal communication, 1983) are included in this report in order to clarify some of his positions and opinions concerning the above discusion of the data, and the data base as a whole:

"Anyone who would be interested in the data should be clearly warned that there is not any reason to utilize samples with great size variance, or those which have large numbers of non-scorable samples due to their probable deteriorated state. They served their purpose, to prove that they were not adequate for definitive work due to their being internally heterogeneous with respect to size-age and gene frequencies. That should never be gone through again, it is too exhausting and will prove little beyond what is already stated."

"I do not hesitate to state that scoring errors are part of the problem in any analytical technique, but in selecting and utilizing odd phenotype combinations as standards over the years and in normal situations where bloods were collected from fresh caught fish, quality deterioration was negligible. The quality problems were big in the frozen fish sampling due to stomach fluid contaminations. These were readily recognizable due to 'flaring' of the samples rather than banding; and you will find innumerable reruns during this period, including Sephadx, etc. in order to cope with these problems.

"If someone wants to study sample stability it can quickly be done from the cache of 'standards'. These were shared with Lewis and Richardson and no one ever complained."

And in summary,

"The better data sets are those from the collections of uniform fish, analyzed in sequence in that these have internal standardization, hence little question about scores and resulting frequencies. Their utility is quite clearly outlined in all of the early reports, in spite of typos and editorial disasters. The other possible analysis from the data have been done and I am not sure what will ever come of them. But the results are not different than I stated in 1977-1978."

TABLE 1.

	TAUR G		TAUR G1		REANALYSES											
	9/4/75		Transform of 9/4/75		9/5/75		9/9/75		9/9/75		9/22/75		1/6/76		1/8/76	
Sampler	EST	TFN	EST	TFN	EST/TFN		EST/TFN		EST/TFN		EST/TFN		EST/TFN		EST/TFN	
#1	13	23	24	23	13	23	13	23	11	--	--	--	--	23	13	23
#2	23	23	23	23							23	23	--	23		
#6	34	23	12	23	34	23	22	23	22	--	22	23	--	23	34	23
#10	23	11	23	?									--	33	23	33
#11	24	23	13	23	24	23	34	23	34	--	34	23	--	23	--	23
#21	34	33	12	22	34	33	34	23	34	--	34	33	--	--	12	22

	TAUR BI 9/2/75		TAUR B2 Transform of 9/2/75		1/8/76	
#33	23	23	23	23	22	23
#34	12	22	34	33	23	22
#35	22	33	33	22	33	22
#36	23	33	23	22	23	22
#37	22	33	33	22	33	22
#38	12	33	34	22	23	22
#39	23	33	23	22	23	22
#40	22	23	33	23	33	23

Key for Coded Data:

Spaces

(1-6) **Sample code:**
Usually an abbreviation of the vessel name used to identify each sample.

(7-8) **Species:**

YF	Yellowfin	TT	*Thunnus tonggol*
SJ	Skipjack	GS	*Gymnosarda* sp.
PS	Porpoise sp.		

(It should be noted that the yellowfin and skipjack data files contain some data entries for other species.)

(9-14) **Date:**
(9-10) Month (January = 01, February = 02, *etc.*)
(11-12) Day of the month
(13-14) Last two digits of the year

(15-26) **Location:**
(15) Always contains a zero
(16-19) Latitude in degrees and minutes
(20) Hemisphere (N or S)
(21-25) Longitude in degrees and minutes
(26) Hemisphere (E or W)

(27) **Gear:**
Type of gear used in capturing fish.
(1) Purse seine (bolichero)
(2) Baitboat
(3) Composite purse seine (more than 1 set)
(4) Composite baitboat (more than 1 stop or day)
(5) or ( ) Unknown

(28) **Condition of the sample and how it was taken:**
(1) Morphometrics and blood taken from fresh fish
(2) Blood only taken from fresh fish
(3) Morphometrics taken from frozen fish; blood taken from fresh fish
(4) Morphometrics and blood taken from frozen fish
(5) Blood only taken from frozen fish

(29) **Sex:**
(1) Male
(2) Female
( ) Unknown
(0) or (3) Indeterminable

(30-32) **Fish number:**
If each blood sample was given a number when it was taken and the blood samples were analyzed in numerical or random order, then the number on the sampler or vial was used as the fish number. If each blood sample was given a number and the samples were analyzed in order of increasing or decreasing length, then the number assigned to the blood sample in the gel record sheet was used for the fish number. (For analysis samplers

were arranged in racks and dispensed onto a 10X10 matrix depression plate, either by length or by sample number.)

(33-36) Length:
Most of the lengths are recorded in centimeters, and the remainder in millimeters. A 75-cm fish was recorded as " 75 ", a 750-mm fish was recorded as " 750", and a 1002-mm fish was recorded as "1002." The code " NFL" means that no length was available for that fish.

(37) This space is blank.

(38-39) Esterase score:
The esterase phenotype judged to be the most reliable was recorded here. Alternate (conditional or questionable) esterase scores were recorded in col. 49-50.

(40-41) Transferrin score:
The transferrin phenotype judged to be the most reliable was recorded here. An A-B allele numbering system was used for yellowfin and a 1-4 system for skipjack. Alternate (conditional or questionable) transferrin scores were recorded in col. 51-52.

(42,43,47) Repeats (R1, R2, R3)
These three spaces record the number of times that each enzyme system was scored. R1 was for esterases, R2 was for transferrins, and R3 was for PGI. The rules used for assigning values to R1, R2, and R3 were as follows:

(0) Unscorable

a) The blood sample was analyzed once and was not scorable for the system.

b) The blood sample was analyzed, a conditional score was or was not assigned, and the electrophoretic gel record was marked "RR." The blood sample was then reanalyzed for the system in question and the score was again indeterminable. In these cases the columns for the most reliable score would be blank, and, if a conditional score had been assigned, it would be recorded in the appropriate alternate score columns.

c) In cases where blood samples were analyzed and scored three or more times, and each time the blood sample was analyzed the banding pattern was unclear or scorings varied, this was considered the same as unscorable.

(1) The blood sample was analyzed and scored once.

(2) The blood sample was analyzed twice for the same system.

a) The blood sample was analyzed twice, and the same phenotype was obtained both times.

b) the blood sample was analyzed, given a conditional score, and the electrophoretic gel record was marked "RR." The blood sample was reanalyzed, and the score assigned was the same as the conditional score.

c) The blood sample was analyzed, given a conditional score, and the electrophoretic gel record was marked "RR." The blood sample was reanalyzed, and the score assigned was not the same as the conditional score. In this case the conditional score was recorded in the alternate score column, and the second scoring was recorded in the most reliable column.

(3) The blood sample was analyzed for the same system three times.
a) The blood sample was analyzed three times for the same system and the same phenotype was obtained in all cases.
b) If a blood sample was analyzed three times, twice obtaining one score and once obtaining another score, then the score that was assigned once would be recorded in the alternate score column and the score that was assigned twice would be recorded in the most reliable column.

(4, 5, etc.) The blood samples were analyzed more than three times.
a) The blood samples were analyzed for the same system four or more time, and the same phenotype was obtained in all cases. These samples are usually those that had been used as standards in a number of different electrophoretic gels. It was not a common practice to analyze a sample more than three times if there was some ambiguity in the scoring. All samples that were analyzed three or more times without arriving at a consistent score were considered unscorable.

(44) This space is blank.

(45-46) <u>PGI score:</u>
The PGI phenotype judged to be the most reliable was recorded here. Alternate (conditional or questionable) PGI scores were recorded in col. 53-54.

(47) See 42,43.

(48) This space is blank.

(49-54) <u>Alternate scores:</u>
These scores were tentatively assigned when there was some ambiguity or difficulty reading the starch gels.
(49-50) Alternate esterase scores
(51-52) Alternate transferrin scores
(53-54) Alternate PGI scores

(55) This space is blank.

(56-76) <u>Morphometric measurements:</u>
(56-58) Snout to first dorsal
(59-61) Snout to second dorsal
(62-64) Snout to anus
(65-67) Head length
(68-70) First dorsal to second dorsal
(71-73) First dorsal to anus
(74-76) Second dorsal to anus

REFERENCES

Anonymous, 1970. Annual Report of the Inter-American Tropical Tuna Commission, 1969:117 p.

____. 1973. Annual Report of the Inter-American Tropical Tuna Commission, 1972:166 p.

____. 1974. Annual Report of the Inter-American Tropical Tuna Commission, 1973:150 p.

____. 1977. Annual Report of the Inter-American Tropical Tuna Commission, 1976:180 p.

____. 1980. Review of Preliminary Results from Genetic Analysis of Skipjack Blood Samples Collected by the Skipjack Survey and Assessment Programme. South Pacific Commission, Technical Report, 1:22 p.

____. 1981. Report of the Second Skipjack Survey and Assessment Programme Workshop to Review Results from Genetic Analysis of Skipjack Blood Samples. South Pacific Commission Technical Report, 6:38 p.

Allendorf, F. W. and Utter, F. M. 1979. Population Genetics. in Hoar, W. S., Randall, D. J., and Brett, J.R. editors. Fish Physiology. New York: Academic Press, Inc. 8:407-454.

Avise, J. C. and Kitto, G. B. 1973. Phosphoglucose Isomerase Gene Duplication in the Bony Fishes: An Evolutionary History. Biochem. Genetics, 8(2):113-132.

Barrett, I. and Tsyuki, H. 1967. Serum Transferrin Polymorphism in Some Scombroid Fishes. Copeia, (3):551-557.

Barrett, I. and Williams, A. A. 1967. Soluble Lens Proteins of Some Scombroid Fishes. Copeia, (2):468-471.

Cushing, J. E., Ridgway, G. J., and Durall, G. L. 1957. The Preservation of Intact Erythrocytes of Marine Vertebrates For Blood Group Research. Biol. Bull., 113(2):343-344.

Dando, P. R. 1974. Distribution of Multiple Glucosephosphate Isomerases in Teleostean Fishes. Comp. Biochem. Physiol., 47(3B):663-679.

Davidoff, E. B. 1963. Size and Year Class Composition of Catch, Age and Growth of Yellowfin Tuna in the Eastern Tropical Pacific Ocean. 1951-1961. Inter-Amer. Trop. Tuna Comm., Bull., 8(4):199-251.

Dixon, W. J. 1974. BMD Biomedical Computer Programs. Berkeley: University of California Press: 733 p.

Fujino, K. 1966. Instructions for Collecting Blood and Serum Samples from Tuna Fishes. FAO, Fish. Circ., (26):1-15.

____. 1969. Atlantic Skipjack Tuna Genetically Distinct from Pacific Specimens. Copeia, (3):626-629.

____. 1970. Immunological and Biochemical Genetics of Tunas. American Fish. Soc., Trans., 99(1):152-178.

____. 1976. Subpopulation Identification of Skipjack Tuna Specimens from the Southwestern Pacific Ocean. Jap. Soc. Sci. Fish., Bull., 42(11):1229-1235.

Fujino, K., Sasaki, K. and Okumura, S. 1981. Genetic Diversity of Skipjack Tuna in the Atlantic, Indian and Pacific Oceans. Jap. Soc. Sci. Fish., Bull., 47(2):215-222.

Fujino, K. and Kang, T. 1968a. Serum Esterase Groups of Pacific and Atlantic Tunas. Copeia, (1):56-63.

____. 1968b. Transferrin Groups of Tunas. Genetics, 59:79-91.

Hennemuth, R. C. 1961. Size and Year Class Composition of Catch, Age and Growth of Yellowfin Tuna in the Eastern Tropical Pacific Ocean for the Years 1954-1958. Inter-Amer. Trop. Tuna Comm., Bull., 5(1):1-112.

Knudsen, P. F. 1977a. Population Structure of Yellowfin Tuna As Inferred from Spawning Groups. San Diego CA: San Diego State University, M.S. Thesis:88p.

Knudsen, P. F. 1977b. Spawning of Yellowfin Tuna and the Discrimination of Subpopulations. Inter-Amer. Trop. Tuna Comm., Bull., 17(2):117-169.

Marr, J. S. 1957. The Problem of Defining and Recognizing Subpopulations of Fishes. U.S. Fish Wild. Serv., Spec. Sci. Rep.-Fish., 208:1-6.

Marr, J. S. and Schaefer, M. B. 1949. Definitions of Body Dimensions Used in Describing Tunas. U.S. Fish Wild. Serv., Fish. Bull., 51(47):241-244.

Richardson, B.J. 1983. Distribution of Protein Variation in Skipjack Tuna, Katsuwonus pelamis, from the Central and South-western Pacific. Aust. J. Mar. Freshw. Res., 34:231-251.

Sharp, G.D. 1969. Electrophoretic Study of Tuna Hemoglobins. Comp. Biochem. Physiol., 31(5):749-755.

____. 1972. Studies of the Biochemical Genetics of Yellowfin Tuna of the Eastern Pacific Ocean. La Jolla CA: Scripps Institution of Oceanography, Ph.D. Dissertation:75 p.

____. 1973. An Electrophoretic Study of Hemoglobins of Some Scombroid Fishes and Related Forms. Comp. Biochem. Physiol., 44(2B):381-388.

____. 1978. A Population Study of Some Tropical Pacific Tunas with Emphasis on Evolutionary Implications Inferred from Distribution, Morphological, Age Frequency, and Biochemical Genetic Data. IATTC unpublished Manuscript.

Sharp, G. D. and Dizon, A. E. editors. 1978. The Physiological Ecology of Tunas. New York: Academic Press, Inc.:485 p.

Sharp, G. D. and Francis, R. C. 1976. An Energetics Model for the Exploited Yellowfin Tuna, Thunnus albacares, Population in the Eastern Pacific Ocean. U.S. Nat. Mar. Fish. Serv., Fish. Bull., 74(1):36-51.

Sharp, G. D., Mobrand, L. E. and Francis R. C. 1970. A Discussion of the Relation Between Sample Size and Power in the Design and Interpretation of Chi-square Testing in Genetic Population Data. IATTC unpublished manuscript.

Sharp, G. D. and Pirages, S. 1978. The Distribution of Red and White Swimming Muscles, their Biochemistry, and the Biochemical Phylogeny of Selected Scombrid Fishes. In Sharp, G. D. and Dizon, A. E. editors. The Physiological Ecology of Tunas. New York: Academic Press. Inc.:41-78.

Shaw, C. R. and Prasad, R. 1970. Starch Gel Electrophoresis of Enzymes-a Compilation of Recipes. Biochem. Genetics, 5 (4):297-320.

Shimada, B. M. and Schaefer, M. B. 1956. A Study of Changes in Fishing Effort, Abundance, and Yield for Yellowfin and Skipjack Tuna in the Eastern Tropical Pacific Ocean. Inter-Amer. Trop. Tuna Comm., Bull., 1(7):351-469.

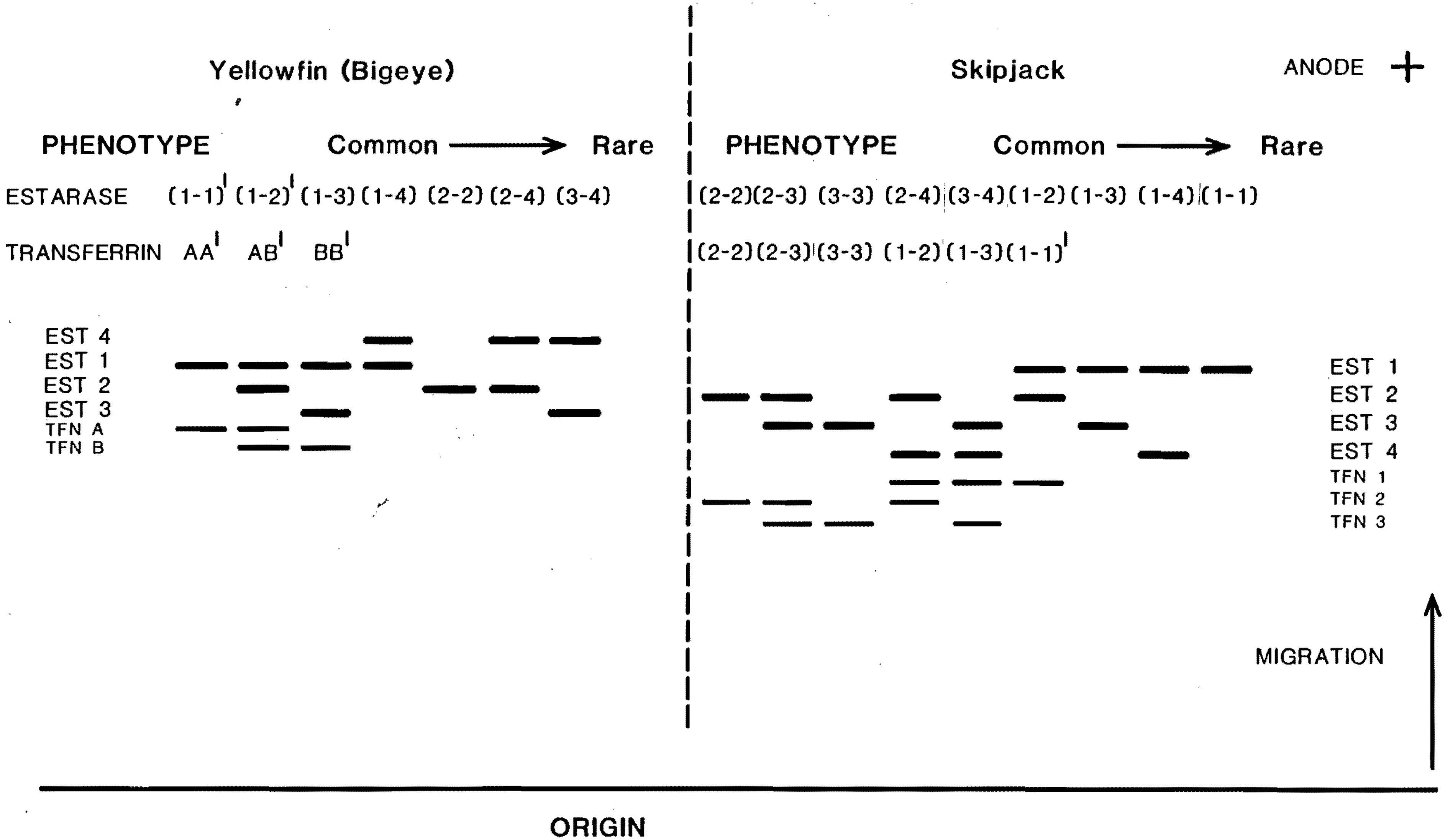
Sprague, L. M. 1967. Multiple Molecular Forms of Serum Esterase in Three Tuna Species from the Pacific Ocean. Hereditas, 57(11):198-204.

Tsuyuki, H., Roberts, E., Kerr, R. H., and Donald, A. P. 1966. Micro Starch Gel Electrophoresis. Fish. Res. Bd. Can., J., 23(6)929-933.

APPENDICES

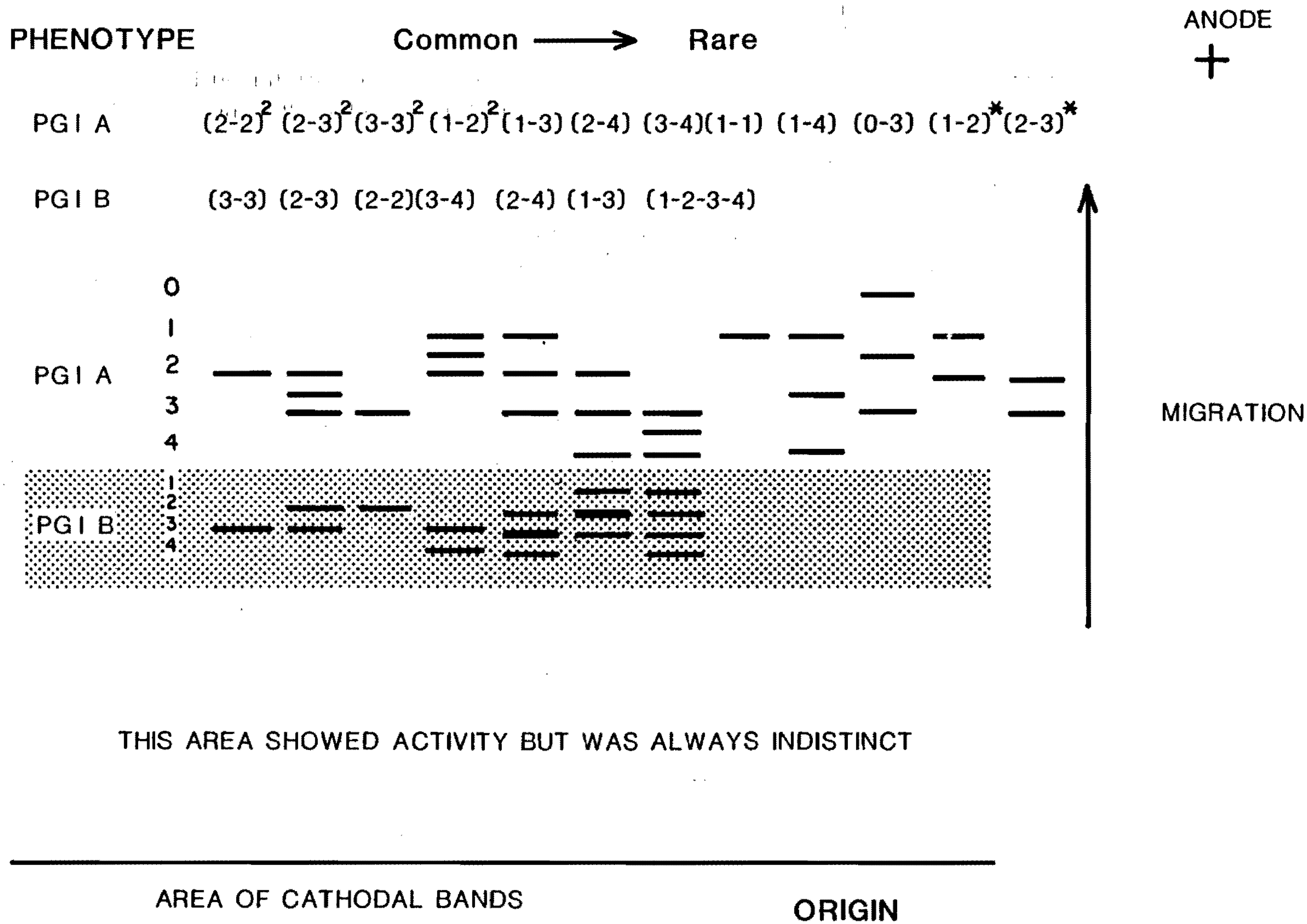
1) Addendum 1 and 2 from Sharp (1972).
2) Sampling instructions.
3) Yellowfin sample index.
4) Skipjack sample index.
5) Memorandum from Robert Francis to John R. Caliprice.
6) Summary of the phenotypic frequencies for each yellowfin sample.
7) Summary of the phenotypic frequencies for each skipjack sample.

FIGURE 1. Esterase and transferrin phenotypes of yellowfin, bigeye, and skipjack.



I – Observed in both yellowfin and bigeye.

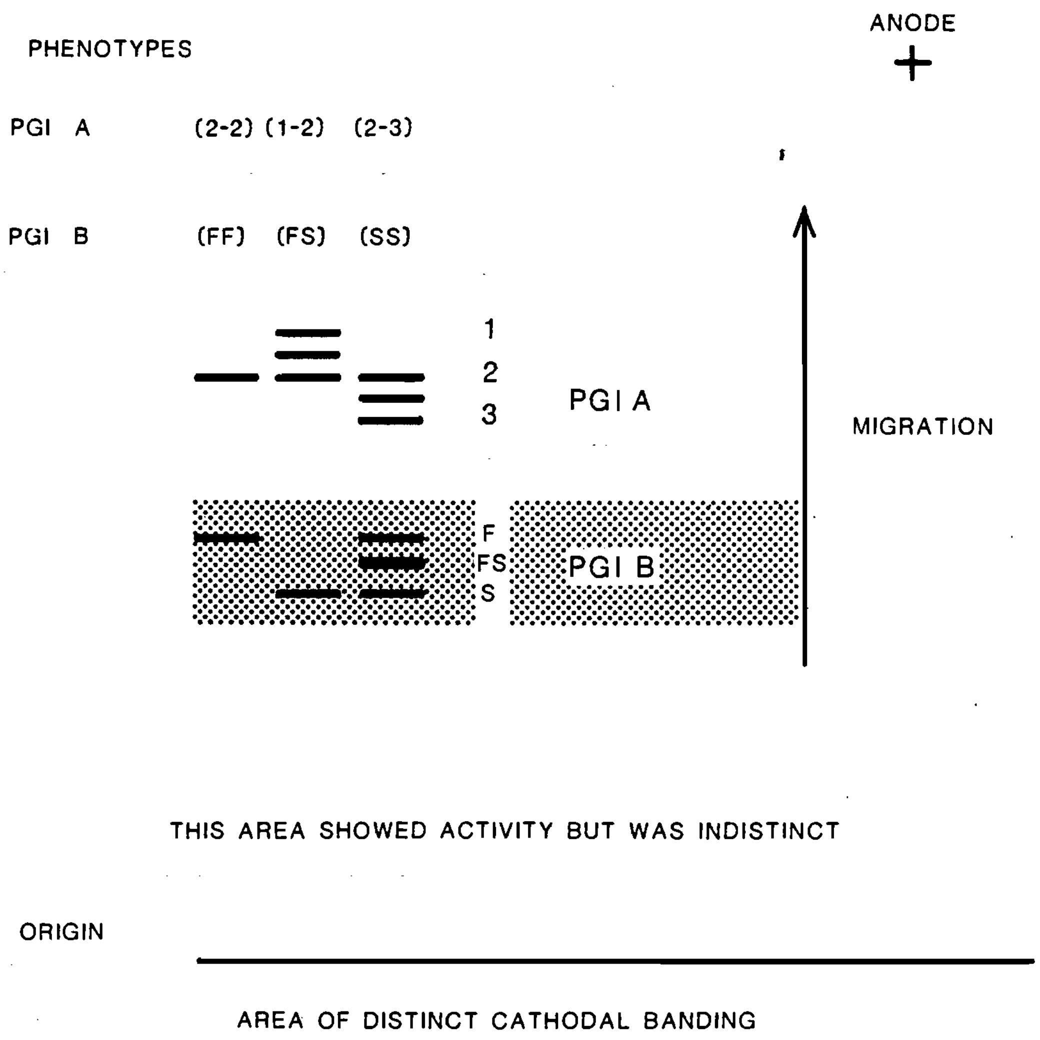
FIGURE 2. PGI phenotypes of yellowfin and bigeye.



* - Exhibited no intermediate heterozygous band.

2 - Observed in both yellowfin and bigeye.

FIGURE 3. PGI phenotypes of skipjack.



APPENDIX 1.

Addendum 1 and 2 from Sharp (1972).

This material was taken from Gary Sharp's PHD thesis
Scripps institute of Oceanography 1972

ADDENDUM 1

I.

A. Dehydrogenase methods

Dehydrogenase Stock buffer, pH = 7.8

TRIS (SIGMA 7-9)	121 gm
Citrate	51 gm
H_2O	to 1 liter

Tank buffers 1:3 of stock buffer, pH 7.8

Gel buffer 1:60 of stock buffer

Dilutions are made up with distilled water

Gels are made up with 300-330 ml of gel buffer and 34.5 grams of prehydrolysed starch (Connaught).

B. Modified Fujino method:

Tank and gel stock buffers

1) 0.3 M Borate, pH = 8.2 (adjusted with NaOH)

2) 0.018 M LiOH and 0.19 M Borate, pH = 7.8

3) 0.0054 M Citrate and 0.04 M TRIS (Sigma 7-9) pH = 7.2

Buffer number one is used in the anodal tank. Buffer number two is used in the cathodal tank. The gel is made up of 250 ml of buffer number two and 80 ml of buffer number three and 34.5 grams of prehydrolysed starch (Connaught).

The 300 ml of gel buffer makes up two gels (147 x 212 x 5mm). The starch is suspended in 100 ml of the buffer solution and the remaining 200 ml of the buffer solution is brought to near boiling temperature. The warmed buffer is added to the starch suspension and brought to a slow boil. Care is taken to evenly heat the starch solution by vigorous agitation of the solution while heating. Negative pressure is applied to the solution with an aspirator. This degasses the solution and the gels are then poured into the forms. After a short period at room temperature the gels become slightly opaque. They have a firm consistency and are then transferred to a 4°C refrigerator to set and equilibrate to the 4°C running conditions. After the gels have reached 4°C, they are fairly firm and resilent. Thirteen sample slots are made in each gel with a square tipped spatula. The samples are applied to the gels on individual 3 x 5 mm pieces of Whatman number 3 filter paper. The gels are subjected to electrophoresis for from three to six hours, depending on the resolution and separation required, at 4°C in a humidity saturated environment. The milliamperage for each gel should not exceed 50 at any time and the maximum voltage applied should be determined by the relation mA x V $\leq$ 9,000 m Watts, below which value there generally is not overheating. A typical gel is run at 45 mA and 200 volts for three hours and gives a migration of the frontal material of approximately five centimeters. Longer runs tend to yield diffuse band patterns but greater separation. The gels are stained by immersion into staining solutions. The staining processes are generally carried out in the dark due to the effect of light on the precipitation reactions characteristic of each stain. After staining is obtained, the gels are washed and fixed in methanol, H_2O and acetic acid solution (4.5:4.5:1) and photographed or stored for future reference.

C. Dehydrogenase Developer Buffers

1) 0.5 M TRIS-HCL, pH 7.1

2) 0.5 M TRIS-HCL, pH 8.8

Stain solutions:

Nitro blue tetrazoliam	40 mg
DPN (NAD^+)	40 mg
Phenazine methosulfate (PMS)	10 mg
MgCl (Saturated solution)	0.5 ml
Appropriate developer buffer	100 ml
2 M Substrate (or 95% ethanol)	4 ml

(a) Alcohol DH, α-glycerophorphate DH, 15 ml 0.1 M KCN
Use developer buffer #1. Incubate overnight.

(b) Glutamate DH, Lactate DH, Malate DH
Use developer buffer #2. Incubate for 1 hour at 37°C in dark.

II.

A. Esterase Developer Buffer, pH 6.55

10.5 gm NaH_2PO_4	10.5 gm
8.95 gm Na_2HPO_4	8.95 gm
H_2O	to 1 liter

Substrate solution:

1% α-napthyl ester	2 ml
Fast garnet	40 mg
Fast blue in Esterase developer buffer	40 mg

Incubate for 15-60 minutes in the dark at 37°C

B. Leucine Aminopeptidase, pH 6.0

Stain buffer stock solutions

1) TRIS (Sigma 7-9)	24.2 gm
Maleic acid	23.2 gm
H_2O	to 1 liter
2) 0.2 M NaOH	

Stain buffer

Solution 1	40 ml
Solution 2	26 ml
H_2O	to 200 ml

Stain solution:

Stain buffer	50 ml
Black K salt	50 mg
L-leucyl-B-napthylamide	20 mt
H_2O	50 ml

Incubate at 37°C for one hour.

ADDENDUM 1 - TABLE 1

REFERENCES TO TECHNIQUES

Transferrin	1. Fe^{59} labeling technique as described by Barret, 1967. 2. Amido black staining as used by Fujino's laboratory.
Esterases	
α-napthyl-acetate -propionate -caprylate -laurate	1. Shaw and Prasad, 1970. 2. Fujino. 1968 (α-napthyl-acetate only).
α-glycerophosphate	1. Shaw and Prasad (1970). 2. Nyman (1967).
Lactate DH	1. Morrison and Wright (1966). 2. Sensabaugh and Kaplan, 1972.
Malate DH	1. Shaw and Prasad, 1970. 2. Sensabaugh (personal communication).
Glutamate DH	1. Smith, 1968. 2. Shaw and Prasad, 1970.
Alcohol DH	1. Smith, 1968. 2. Shaw and Prasad, 1970.
Leucine-amino-peptidase	1. Smith, 1968. 2. Shaw and Prasad, 1970.

ADDENDUM 2

Consider the 2 x 2 χ^2 contingency table and the hypothesis of homogeneity

$$H_o : P_1 = P_2 = P$$

against the alternative hypothesis $H_A : P_1 = P + (\frac{C}{\sqrt{N}})$ and $P_2 = P - (\frac{C}{\sqrt{N}})$. Then under H_A the limiting distribution of the usual χ^2 test statistics is the noncentral χ^2 distribution with 1 degree of freedom and noncentrality parameter:

$$\lambda = \frac{4\ C^2 n_1 n_2}{P-(1-P)N^2} \tag{1}$$

(Chapman and Nam, 1968 and Meng and Chapman, 1966).

A statistic having this distribution is described by $\chi^2, (\lambda)$. The resulting power of the test is given by 1-β where β = Probability $\chi^2{}_1(\lambda) > \chi^2{}_{1,\alpha}$ where $\chi^2{}_{1,\alpha}$ is the critical value of the χ^2 distribution with 1 d.f. corresponding to the significance level.

If H_A is written $P_1 = P_2 + \Delta$, (1) becomes

$$\lambda = \frac{\Delta^2 n_1 n_2}{P(1-P)N} \tag{2}$$

Values of λ are tabulated in the literature for various combinations of α and β levels. The requisite sample sizes required for given values of α, β, P and Δ are obtained from equation (2).

APPENDIX 2.

Instructions issued to persons taking blood and morphometric samples.

Morphometrics and Blood Sampling in the Pacific Ocean. (1972)

1. No fish over 105 cm is to be sampled.
2. Samples will consist of 200 fish in a range of 10-12 cms based on the occurrence of a mode or abundance of smaller fish. The enclosed form is to be used as a guide for collecting the 200 animal samples. The samples will be taken in the months of July, August or September. Under the appropriate column heading a series of approximations of lengths are given.
   These groups are assumed to be relatively homogeneous. The 200 fish samples should be collected within one of these ranges when possible.
   Occasionally a sample is encountered where the mode is centered on or near the size indicating a division of two of these intervals. When this is apparent, the sample should be collected assumming that 10-12 centimeters is the maximum range of overall sizes to be collected, and handled in a similar manner to the more usual method. A note should be made in the record book concerning the size interval sampled for every sample. The date, location and sample data should be record~~ed~~ in the provided record book along with the well data and morphometric and tagging I.D. (set # or whatever).
3. Two sets of blood sampled fish should be flagged for morphometric use. The flags and fasteners are provided, prenumbered, and should be placed onto each fish tail and placed into a single well when possible. The flags are numbered from 1-200 and the syringes for blood sampling should be labeled correspondingly. Flag 1 should be placed on the fish from which blood # 1 was collected and so forth.
   The two sets of morphometric fish should be of different size composition if possible.
4. Seven size intervals are given for use in sampling. The optimum sampling scheme would fill each of the seven intervals. This is rarely possible when fishing in a single area, and more commonly the size composition tends to be very similar until large areal shifts are made. If it appears that only 2 or 3 intervals are going to be sampled, repeated sampling can be done fifteen days after the initial sampling of a given interval. Gross area changes (> 100 miles) will make resampling an interval legitimate. An attempt should be made to sample at all the intervals, even though an area change has been made.

July	Aug.	Sept.	Oct.
30-49	33-42	36-45	30-39
40-49	43-52	46-55	40-49
50-58	53-62	56-65	50-58
59-69	63-73	66-79	59-69
70-84	74-87	80-91	70-84
85-95	88-98	92-102	85-95
96-105	99-105	103-105	96-105

For use in collecting blood samples in the Pacific Ocean.only

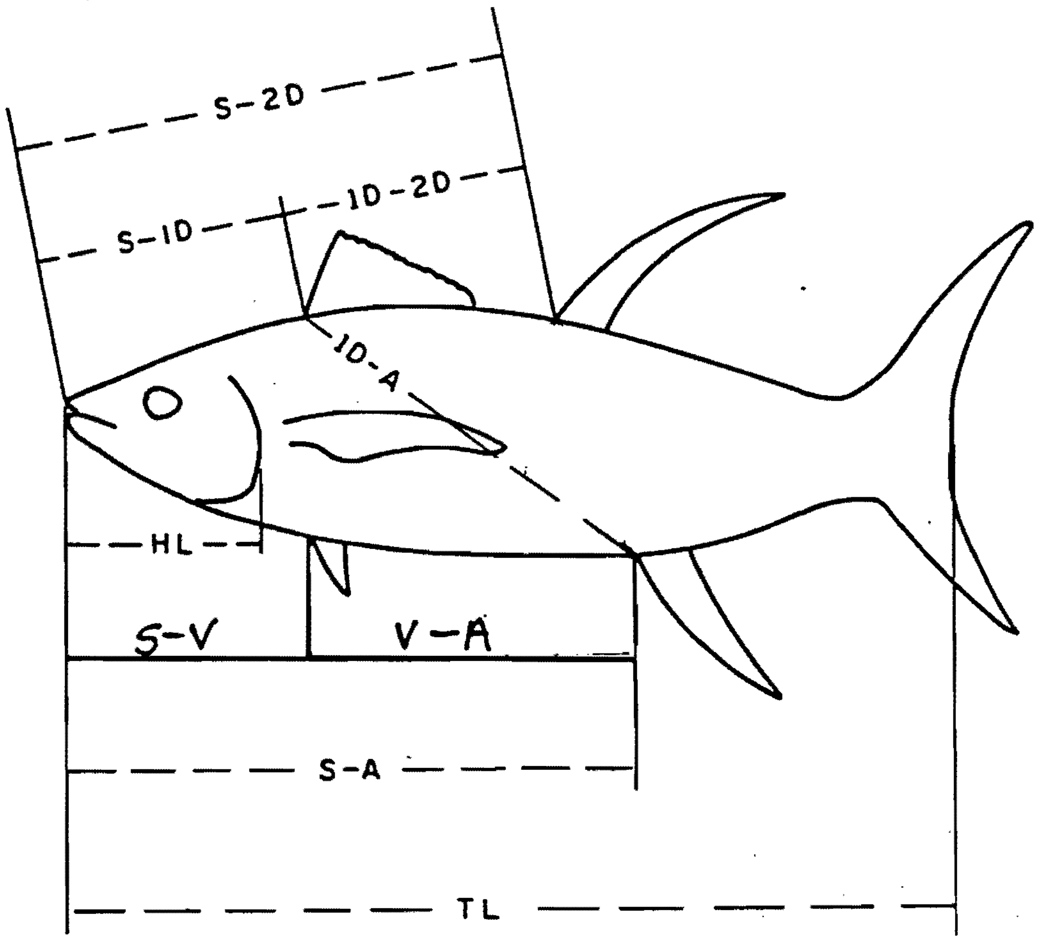
(This is an example of the modal progression used in assigning groups in 1972.)

(Month of origin)

Age in Nov.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Nov. 0											33	36	40
Oct. 1										33	36	40	43
Sept. 2									33	36	40	43	46
Aug. 3								33	36	40	43	46	50
July 4							33	36	40	43	46	50	53
June 5						33	36	40	43	46	50	53	56
May 6					33	36	40	43	46	50	53	56	59
Apr. 7				33	36	40	43	46	50	53	56	59	63
Mar. 8			33	36	40	43	46	50	53	56	59	63	66
Feb. 9		33	36	40	43	46	50	53	56	59	63	66	70
Jan. 10	33	36	40	43	46	50	53	56	59	63	66	70	74
Dec. 11	36	40	43	46	50	53	56	59	63	66	70	74	80
Nov. 12	40	43	46	50	53	56	59	63	66	70	74	80	85
Oct. 13	43	46	50	53	56	59	63	66	70	74	80	85	88
Sept. 14	46	50	53	56	59	63	66	70	74	80	85	88	92
Aug. 15	50	53	56	59	63	66	70	74	80	85	88	92	96
July 16	53	56	59	63	66	70	74	80	85	88	92	96	99
June 17	56	59	63	66	70	74	80	85	88	92	96	99	103
May 18	59	63	66	70	74	80	85	88	92	96	99	103	106
Apr. 19	63	66	70	74	80	85	88	92	96	99	103	106	109
Mar. 20	66	70	74	80	85	88	92	96	99	103	106	109	112
Feb. 21	70	74	80	85	88	92	96	99	103	106	109	112	114
Jan. 22	74	80	85	88	92	96	99	103	106	109	112	114	116
Dec. 23	80	85	88	92	96	99	103	106	109	112	114	116	121
Nov. 24	85	88	92	96	99	103	106	109	112	114	116	121	123
Oct. 25	88	92	96	99	103	106	109	112	114	116	119		
Sept. 26	92	96	99	103	106	109	112	114	116	119	121		
Aug. 27	96	99	103	106	109	112	114	116	119	121	123		
July 28	99	103	106	109	112	114	116	119	121	123	126		
June 29	103	106	109	112	114	116	119	121	123	126	128		
May 30	106	109	112	114	116	119	121	123		128	130		
Apr. 31	109	112	114	116	119	121	123			130	132		
Mar. 32	112	114	116	119	121	123				132			
Feb. 33	114	116	119	121	123					134			
Jan. 34	116	119	121	123						136			
Dec. 35	119	121	123							137			
Nov. 36	121	123											
Oct. 37	123												
Sept. 38	126												
Aug. 39	128												
July 40	130												
June 41	132												

Yellowfin Tuna Morphometrics

(1970-1972)



The following morphological characteristics were measured on each fish (Fig. 19): 1) total length; 2) snout to insertion of first dorsal fin; 3) snout to insertion of second dorsal; 4) snout to insertion of anal; 5) snout to insertion of ventral; 6) head length; 7) insertion of first dorsal to insertion of second dorsal; 8) insertion of ventral to insertion of anal; 9) insertion of first dorsal to insertion of anal.

TAGGING CRUISE INSTRUCTIONS (1972-1973)

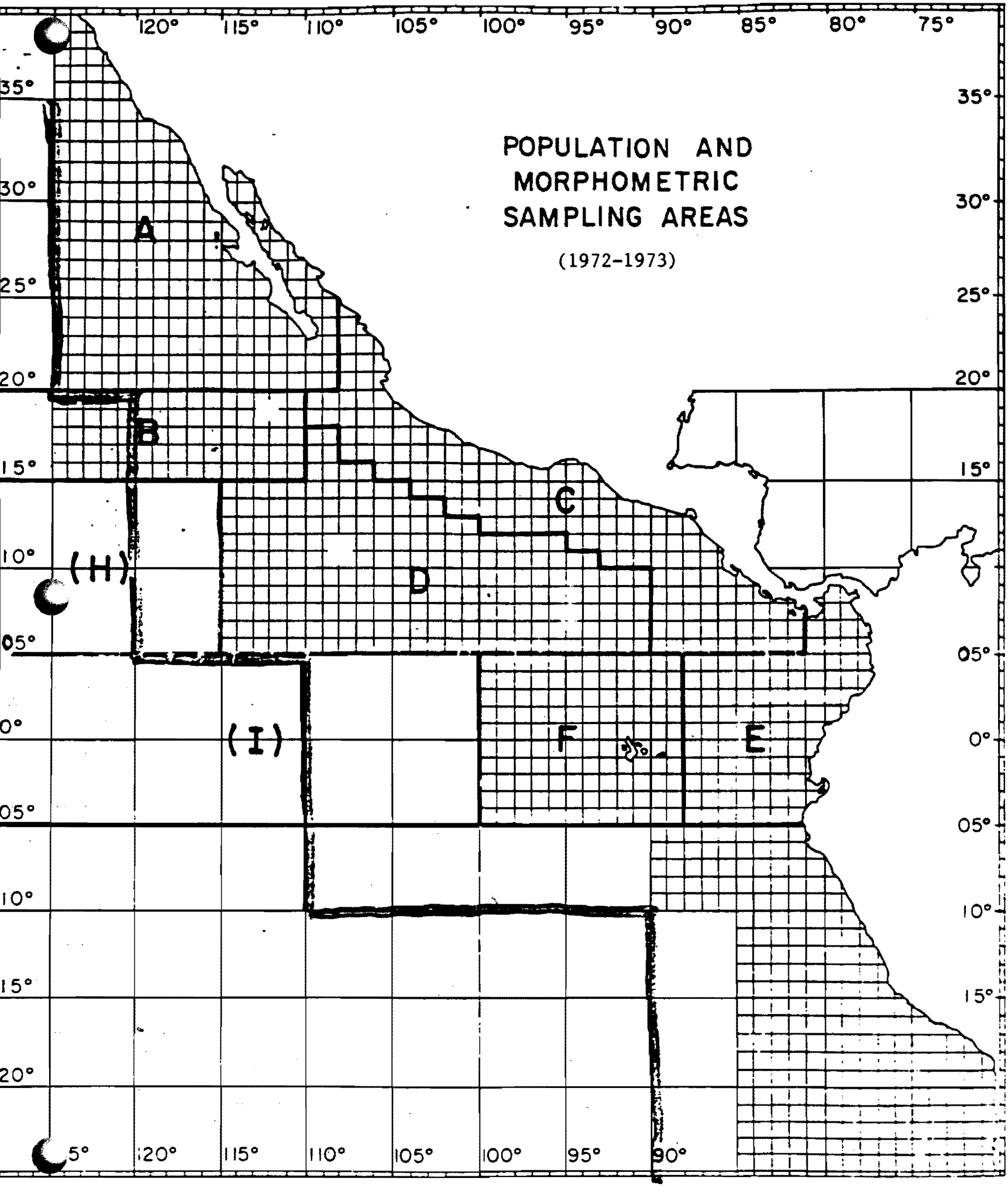
1. Flagging fish with morphometric and blood sampling:

   Select 200 fish (~ 1-2 tons of fish 50-70 cm long) within a 12 cm length interval. Blood samples of 2 ml should be drawn from 70 of these fish. As each fish is successfully sampled a flag should be attached above the caudal peduncle. The flags are numbered and the appropriate number should be written on the blood sample vial. When 70 blood samples have been collected, the fish from which the bloods were drawn should have morphometric measurements taken and each data set should be appropriatly numbered so that the flagged fish and blood samples can be related. If possible, get the crew to flag the remaining 130-140 animals in the sample and put them into the well. The well number should be recorded and position, date of capture, etc, recorded in the daily log. Two samples (one from large (85cm) and two consecutive from small (85cm) fish) are to be collected in this fashion.
2. Flagging fish:

   Sufficient flags (3 sets of 210) are provided to flag 3 sets of fish, preferable from 3 distinct areas. If it appears that the trip is going to only visit one general area (e.g., local Banks, Mexican coast or Revillagigedos) a replicate sample, a sample of fish similar in length to the sample of fish from which bloods and morphometrics were sampled should be flagged, and if possible the third set of flags should be used on another size class of animals than that previously sampled. If three areas are worked, there is best to flag animals of similar length intervals to the blood-morphometric sample.

3. One hundred blood sample vials are provided, seventy of which are to be used on the flagged fish. Sufficient RBC preservative is supplied to provide for wastage. Each of the yellowfin in the flagged sample should have only 2 ml drawn. An equal volume of RBC preservative should be drawn into the blood, mixed well and the samplers sealed and stored in the meat freezer.

4. There will be thirty extra samplers available for opportunistic sampling of various fish species which may be encountered during the trip. Samples of wahoo, sierra mackerel, skipjack and black skipjack are to be given priority for this project. Up to 5 ml of blood should be collected from each individuals of these species. Sample as many wahoo and sierra mackerel as are available, but no more than five individuals of any of the other species. These samples should be preserved and stored as described in section 3. The samples need only be identifiable to species. Code the vials and log the code and species in the day log.


POPULATION AND
MORPHOMETRIC
SAMPLING AREAS
(1972-1973)
A
B
C
D
E
F
(H)
(I)
120°
115°
110°
105°
100°
95°
90°
85°
80°
75°
35°
30°
25°
20°
15°
10°
05°
0°
05°
10°
15°
20°

Instructions for Blood Samples and Morphometrics

(1973)

1. Take blood samples and morphometric measurements from 200 yellowfin from each sampling area shown on the enclosed map, for each month (month of capture) of the year. The fish must be unbutchered and must be thawed out before working on them.
2. Each 200-fish sample must come from a well containing yellowfin from a single set or stop, except that samples should be taken also from baitboats landings from islands or banks where fishing was continuous and in which one or more wells of island or bank fish are available from any single location, but not necessarily from a single stop or day.
3. Fish sampled must be under 110 cm long, preferably from within a 10-15 cm size range and from one modal groups (* See note on last page of these instructions).
4. After thawing the fish take morphometric measurements from 50 fish in good condition (no broken tails, etc.) over the complete size range. (See attached sheet showing which morphometric data are required).
5. Next, take blood samples from the <u>same</u> 50 fish used for morphometrics, in the same order. The boring tool should be inserted into the heart region and a core removed. Two ml of fluid blood are then drained into a vial. The boring tool must be rinsed between uses. Care should be taken not to contaminate the vials with slime or other debris when collecting blood.
6. The blood sample vials for these 50 fish must be marked so that we can later tell which blood sample belongs to which set of morphometric data. For example, when you draw blood from fish #35, mark the vial with "35 M" (the letter "M" stands for "Morphometric") so that we will know that that particular blood sample came from fish # 35 in the morphometric sample of 50 fish.
7. Next, take blood samples in the same way from the remaining 150 fish. However, these sample vials need only be marked with the length (nearest cm) of each fish.
8. Bag the blood vials in sample lots and freeze them as soon as possible. Keep them frozen until carried or shipped to La Jolla.
9. Send morphometric data and blood samples to La Jolla about once a month along with information about the origin of the samples. Use information sheets provided to record this information. Samples from T.I. should be hand-carried to La Jolla. Samples from Mayaguez should be hand-carried to San Juan and put aboard a direct flight to San Diego.

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* Note: If time permits, more than one sample should be collected if the length

interval of the available fish has not been previously sampled within the capture month. For example, for capture month February in Area C, if one sample of 200 fish within the length interval 60-75 cm has been collected and another sample of 200 from 80-90 cm is available, it should be taken. Two samples of the same length interval, however, are unnecessary.

INSTRUCTIONS FOR YELLOWFIN TUNA MORPHOMETRICS

1) Total length (TL). - The distance from the tip of the snout (most anterior point on upper jaw), with jaws closed, to the cartilaginous median part of the caudal fork.

2) Snout to insertion of first dorsal fin (S-1D). - The distance from the tip of the snout to the insertion of the first dorsal fin. The insertion of the first dorsal is the intersection of the anterior margin of the first dorsal spine, when the fin is held erect, with the contour of the back. This point is identical with the most anterior point of the first dorsal fin slot.

3) Snout to insertion of second dorsal fin (S-2D). - The distance from the tip of the snout to the insertion of the second dorsal fin. The insertion of the second dorsal is the intersection of the anterior margin of the second dorsal with the contour of the back when the fin is held erect.

4) Snout to insertion of anal fin (S-A). - The distance from the tip of the snout to the insertion of the anal fin. The insertion of the anal fin is determined in the same way as the insertion of the second dorsal.

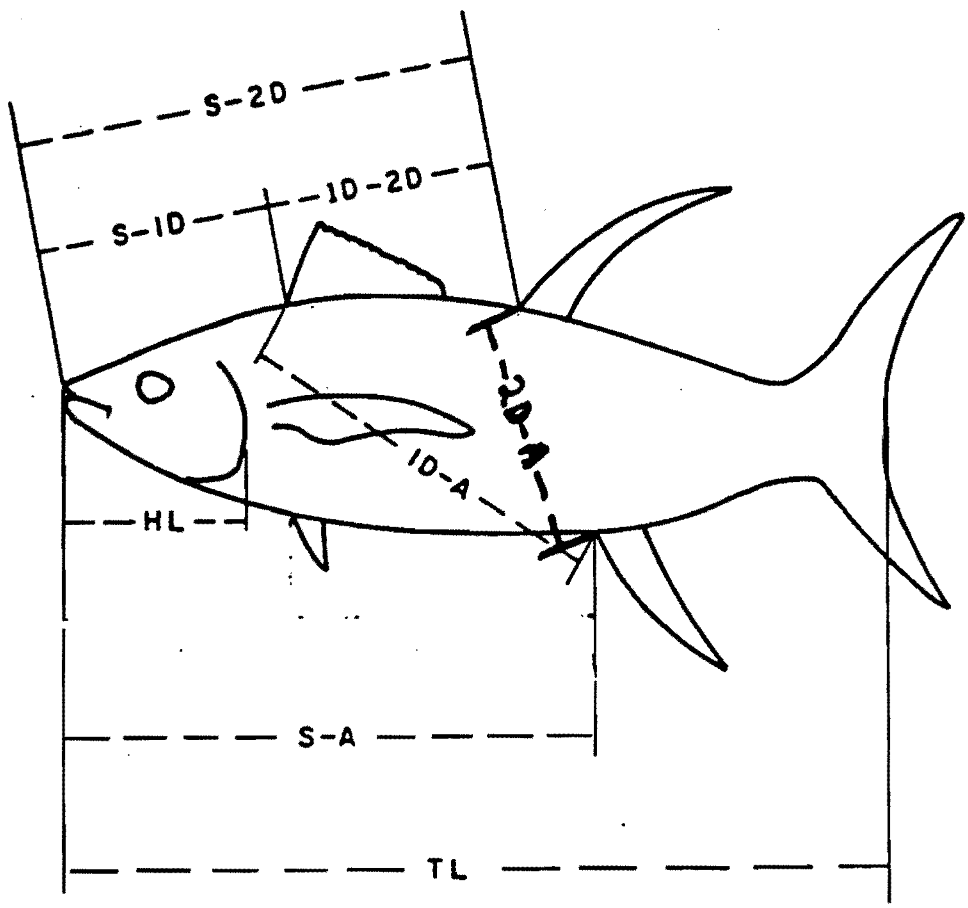
5) Head length (HL). - Distance from the tip of the snout to the most posterior point on the margin of the subopercle (depressing the fleshy flat extending posteriorly).

6) Insertion of first dorsal fin to insertion of second dorsal fin (1D-2D). - The distance from the insertion of the first dorsal fin (defined in 2) to the insertion of the second dorsal fin (defined in 3).

7) Insertion of first dorsal fin to insertion of anal fin (1D-A). - The distance from the insertion of the first dorsal fin (defined in 2) to the insertion of the anal fin (defined in 4).

8) **Insertion of second dorsal fin to insertion of anal fin (2D-A). - The distance from the insertion of the second dorsal fin (defined in 3) to the insertion of the anal fin (defined in 4).**

Yellowfin Tuna Morphometrics



BLOOD SAMPLING TECHNIQUES

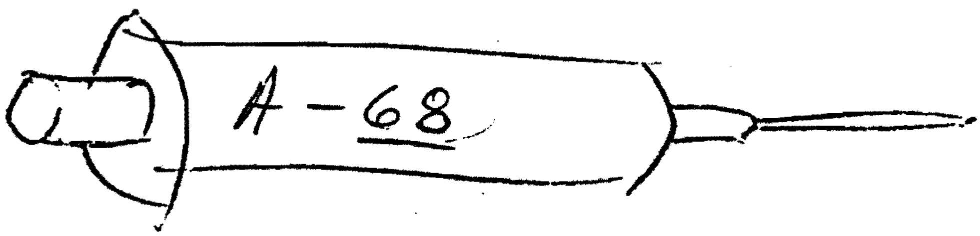
(1974)

1. Each sampler (syringe) should be maintained sterile until just prior to its use.

2. A sterile needle with protective cap should be placed on each syringe just prior to its use.

3. 4 m. of blood should be collected from the heart or gill area of each sample animal. Care should be taken to sample each fish only once.

4. The length of each fish sampled should be written on the sampler as shown below:



so that all numbers read from the right of the sample identifications letter (A-1).

See FRANCIS FOR SAMPLER I.D. for morphometrics

5. Discreet sample identification is necessary - Every sampler should have a length and sample identification letter.

6. Red Blood Cell Preservative (RBC preservative) is provided. After each lot has been collected an equal volume (4 m. of the preservative should be drawn into sampler, the sampler sealed, shaken well and frozen. Samples should not be allowed to thaw after this has been accomplished.

7. The samplers should be placed into the provided shipping containers in a freezer. On the day of shipping, dry ice should be included into the containers. Any excess room in the shipping containers should be utilized to ship empty RBC preservative bottles or data cards to the Commission headquarters for refilling and recording.

8. Plastic sheets are provided for the location data for each sample lot. Example:

Date of Collections and I.D.		Place sample collected	Total
2/27/71	Sample A	Manta embarcadero	200
3/01/71	Sample B	1°20'N, 92°47'W	200
etc.			

This information should be collected and returned with each lot of samples to the Commission's headquarters as soon as possible after the sample total of 200 blood samples have been collected..

9. The shipping containers should be transported by the most direct air route to Commission headquarters.

10. Samples should consist of 200 animals and be collected from one school or small boat, if possible. No animals over 84 cm should be sampled.

11. For on board samples on opportunistic cruises -

    Lots of 200 fish from approximately 40 - 80 cm should be collected from each general fishing area visited, areas should be separated by at least 1 one-degree square or by a 15 day interval within an area, until all samples are filled. Do not return empty samplers - use then up!

12. Also get some secret duplicate blood samples.

BLOOD SAMPLING INSTRUCTIONS

(1974-1976 Eastern Tropical Pacific)

1) Each sample should consist of 200 yellowfin tuna and be collected from one school if possible.

2) Each sample should come from a single modal (age) unit (approx. 15 cm. range in fork length).

3) No fish larger than 100 cm. fork length should be sampled.

4) Each sample should have an identification letter (a, B, C., ...)

5) For each sample, a random subsample of 50 fish should be selected. The following procedure should be followed for each of these fish.

    1) Assign a number (1 - 50) to fish.

    2) Write the assigned number (along with the sample ID letter) on the blood sample vial and then draw the blood from the fish.

    3) Make the following 8 measurements on each fish.

        a) Total length (TL) - distance from the tip of the snout (most anterior point on the upper jaw), with jaws closed, to the cartilaginous median part of the caudal fork.

        b) Snout - 1st Dorsal (PDL) - distance from the tip of the snout to the insertion of the first dorsal (most anterior point of the first dorsal fin slot).

        c) Snout - second dorsal (S-2D) - distance from the tip of the snout to the anterior insertion of the second dorsal.

        d) Snout - Anal - (S-A) - distance from the tip of the snout to the anterior insertion of the anal.

        e) Head Length - (HL) - distance from the tip of the snout to the most posterior point on the margin of the subopercle.

f) First dorsal - Second dorsal - (1D-2D) - distance from the anterior insertion of the first dorsal to the anterior insertion of the second dorsal.

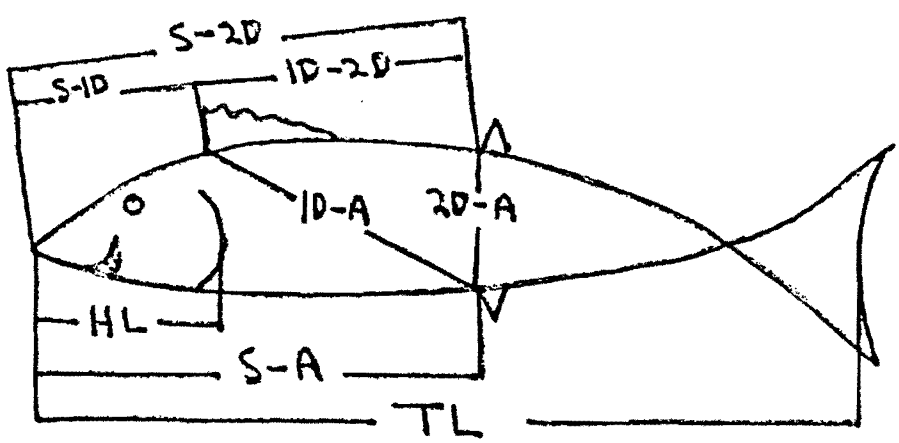
g) First dorsal - Anal - (ID-A) - distance from the anterior insertion of the first dorsal, cross body to the anterior insertion of the anal.

h) Second dorsal - Anal - (2D-A) - distance from the anterior insertion of the second dorsal to the anterior insertion of the anal.

4) Record these measurements along with the number assigned to fish.

All morphometric measurements should be made to the nearest millimeter.

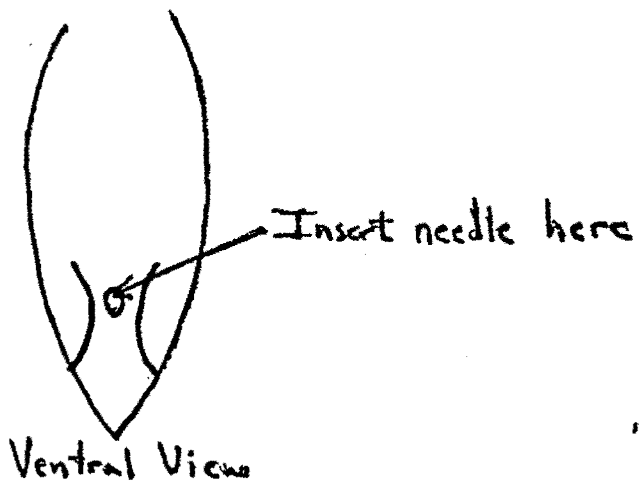
6) For the remaining 150 fish in the sample, blood should be collected and the length (PDL or FL in cm) should be written on the sampler as shown below, along with the sample identification letter, the length should be underlined.



7) Each sampler (syringe) should be maintained sterile until just prior to its use. Do not remove the attached cap until the sample is in the vial.

8) A sterile needle with protective cap should be placed on each syringe just prior to its use.

9) 2 - 4 ml. of blood should be collected from the heart of each sample fish. For most fish the needle can be inserted into the soft spot along the midline just anterior of the ventral fins.



Seal vial with attached cap and dispose of needle. Store the samples away from heat or in refrigerator until preservative is added. Care should be taken to sample each fish only once. Do not freeze yet.

10) Discreet sample identification is necessary - every sampler should have a sample indentification letter and a length (or subsample number in the case of the 50 fish morphometric subsample).

11) Red Blood Cell Preservative (RBC preservative) is provided. After each 200 fish sample has been collected an equal volume (2-4 ml.) or the preservative should be drawn into the sampler, the sampler sealed, shaken well and frozen. Samples should not be allowed to thaw after this has been accomplished.

COMISION INTERAMERICANA DEL ATUN TROPICAL
INTER-AMERICAN TROPICAL TUNA COMMISSION

c/o Scripps Institution of Oceanography
La Jolla, California 92038

WESTERN PACIFIC EXPEDITON

SAMPLING INSTRUCTIONS FOR BLOOD STUDY

(1976)

A. *Information necesssary for processing these samples is: catch date, catch area (to nearest 1°), gear type, associated catch in tons (tons of YF and tons of skipjack for that set that day), sample date, personnel involved in sampling and location of sampling.*

B. *A representative sample of the major size group (contribution in numbers) in the catch should be collected at approximately three week intervals. A replicate sample should be collected within a week of the first sample date and examples of secondary contributions (size range outside the initial 15 cm sampled) should be collected <u>whenever</u> they are available but not to exceed one sample of each secondary size range for each three week sampling period.*

C. *Samples should be collected from one set where possible and composite samples should be clearly labeled as such when they occur. A composite sample is one where due to sparodic or marginal fishing conditions, two or more sets are sampled to fill out the sample requirements. This type of sampling should be kept to a minimum unless the area of capture or size range of the sample makes this sample of interest.*

Samples should be shipped to San Diego via Panama or Los Angeles. Avoid Miami connections if possible. Each shipment should be initiated from Sunday through Wednesday only, and a telegram or radio message should indicate date of departure, number of packages, the waybill number and airline carrier.

E. *Measurment apparatus should be kept dry and in sufficiently good repair as to avoid loss of sampling opportunities. The sampling materials are in boxes which are adequate for shipment of the samples in lots of 400 if the boxes are kept dry. The individual cartons of one hundred samplers should be kept and used to contain units of approximately 100 samples which are to be bagged and sealed in two lots of fifty inside these cartons. This insures adequate security of the samples so as to reduce sample leakage and subsequent weakening of the shipping boxes. The lots of ~ 400 samples should be returned in the larger box which is to be wrapped in plastic and sealed. They should also be securely tied so that rough handling will not result in severe damage. The boxes should be clearly labled as blood samples and the shipping clerks should note this on the handling forms.*

The shipping address hould be as follows:

GARY D SHARP / CLIFFORD PETERSON
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, California 92038

Tel: 453-2820

Telegrams should be sent to:

TUNACOM, San Diego, California

COMISION INTERAMERICANA DEL ATUN TROPICAL
INTER-AMERICAN TROPICAL TUNA COMMISSION

c/o Scripps Institution of Oceanography
La Jolla, California 92038

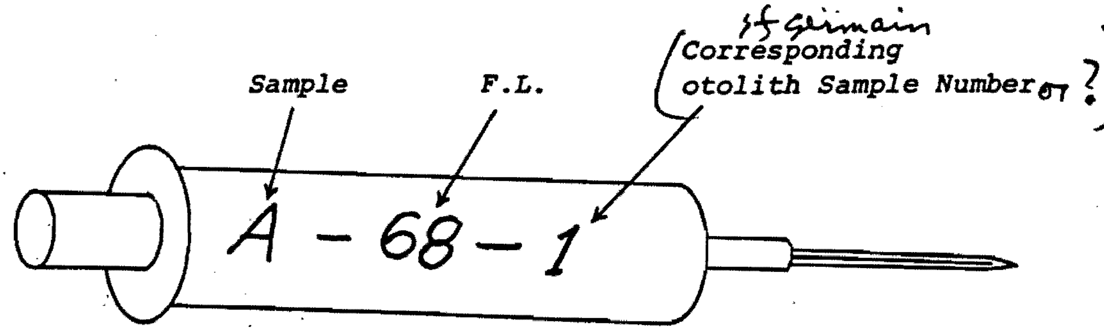
BLOOD SAMPLING TECHNIQUES

1. *EAch sampler (syringe) should be maintained sterile until just prior to its use.*

2. *A sterile needle with protective cap should be placed on each syringe just prior to its use.*

3. *4 m. of blood should be collected from the heart or gill area of each sample animal. Care should be taken to sample each fish only once.*

4. *The length of each fish sampled should be written on the sampler as shown below:*



so that all numbers read from the right of the sample identifications letter (A-1) For the first 20 fish, the blood and otolith samples should be from the same fish, and this noted on the syringes.

5. *Discreet sample identification is necessary - Every sampler should have a length and sample identification letter.*

6. *Red Blood Cell Preservative (RBC preservative) is provided. After each lot has been collected an equal volume (4 m.) of the preservative should be drawn into sampler, the sampler sealed, shaken well and frozen. Samples should not be allowed to thaw after this has been accomplished.* THEY MAY NEVER GET SOLIDS, THAT IS OK.

7. *The samplers should be placed into the provided shipping containers in a freezer. On the day of shipping, dry ice should be included into the containers. Any excess room in the shipping containers should be utilized to ship data to the Commission headquarters for recording.*

8. *location data for each sample lot.*

Example:

Date of Collections and I.D.		*Place sample collected*	*Total*
2/27/71	*Sample A*	*Manta embarcadero*	*200*
3/01/71	*Sample B*	*1°20'N, 92°47'W*	*200*

This information should be collected and returned with each lot of samples to the Commission's headquarters as soon as possible after the sample total of 200 blood samples have been collected.

9. *The shipping containers should be transported by the most direct air route to Commission headquarters.*

10. *Samples should consist of 200 animals and be collected from one school or small boat, if possible.*

11. *For on board sample on opprtunistic cruises.*
Lots of 200 fish should be collected from each general fishing area visited; areas should be separated by at least 1 one-degree square or by a 15 day interval within an area, until all samples are filled. Do not return empty samplers - Use them up !

APPENDIX 3.

Yellowfin sample index (list of yellowfin samples).

SAMPLE		APPENDIX	CRUISE	G		MONTH				NUMBER	NUMBER	DATE	ANALYZED	
CODE	VESSEL	PAGE	NUMBER	CODE	SET	DAY	YEAR	LAT	LOG	MORPHS	BLOODS	EST	TFN	PGI
AKS	AK STROM	6-1		212		04/13	73	007 15 N	083 24 W	50	200	07/19/73	07/19/73	/ /
ANC 2	ANTONINA C	6-1		208		04/15	73	006 23 N	080 59 W	50	207	07/11/73	07/11/73	/ /
ANC 5	ANTONINA C	6-1		209		05/01	73	008 18 N	083 47 W	50	171	07/09/73	07/09/73	/ /
ANM	ANNE M	6-2		211		05/02	73	008 20 N	084 01 W	55	198	06/20/73	06/20/73	/ /
ANM B	ANNE M	6-2	1057	000		08/05	70	010 19 N	135 38 W	0	100	01/12/71	01/12/71	/ /
ANM F	ANNE M	6-2	1057	000		06/24	70	003 20 S	110 44 W	0	27	00/00/71	00/00/71	/ /
ANM G	ANNE M	6-3	1057	000		06/28	70	004 28 N	099 19 W	0	91	00/00/71	00/00/71	/ /
ANM H	ANNE M	6-3	1058	000	29	10/21	70	012 18 N	124 47 W	0	89	01/29/71	01/29/71	10/06/77
ANM I	ANNE M	6-3	1058	000	1	09/10	70	010 04 N	144 40 W	0	247	02/03/71	02/03/71	/ /
ANM J	ANNE M	6-4	1058	000	2	09/11	70	009 46 N	140 50 W	0	87	02/02/71	02/02/71	/ /
ANM K	ANNE M	6-4	1058	000	21	10/03	70	010 00 N	114 38 W	0	218	02/03/71	02/03/71	10/05/77
APL	APOLLO	6-4		210		05/09	73	008 30 N	084 35 W	50	200	07/17/73	07/17/73	/ /
ATL A		6-5		000		10/31	75	000 50 S	001 25 E	0	24	02/19/76	02/19/76	02/09/76
ATL B		6-5		000		11/04	75	001 30 S	005 45 E	0	47	02/19/76	02/19/76	02/09/76
ATL C		6-5		000		11/07	75	002 20 S	001 15 E	0	8	02/20/76	02/20/76	02/10/76
ATL D		6-6		000		11/08	75	001 45 S	001 15 E	0	11	02/23/76	02/23/76	02/11/76
ATL E		6-6		000		11/11	75	001 15 S	001 40 E	0	27	02/23/76	02/23/76	02/11/76
ATL F		6-6		000		11/14	75	004 00 N	010 00 W	0	72	02/23/76	02/23/76	02/11/76
ATL G		6-7		000		11/15	75	005 16 N	010 10 W	0	105	02/24/76	02/24/76	02/17/76
BC	BOLD CONTENO	6-7		205		04/06	73	006 50 N	082 15 W	50	111	07/16/73	07/16/73	/ /
CAC EC	CACHITA	6-7		155		04/09	72	008 00 N	085 20 W	0	181	04/26/72	04/26/72	02/03/78
CAC FC	CACHITA	6-8		154		04/13	72	009 00 N	086 20 W	23	201	04/27/72	04/27/71	02/02/78
CAC FF	CACHITA	6-8	1064	000		09/07	71	023 00 N	113 00 W	0	199	10/28/71	10/28/71	02/13/78
CAC GG	CACHITA	6-8	1064	000		09/09	71	023 00 N	112 47 W	0	250	10/21/71	10/21/71	02/14/78
CAC HH	CACHITA	6-9	1064	000		09/10	71	023 00 N	112 45 W	0	199	10/12/71	10/12/71	02/16/78
CAC II	CACHITA	6-9	1064	000		09/13	71	023 00 N	112 50 W	0	100	10/26/71	10/26/71	02/22/78
CAC JJ	CACHITA	6-9	1064	000		10/10	71	009 50 N	085 55 W	0	141	10/14/71	10/14/71	02/17/78
CNJ A1	CONNIE JEAN	6-10	1055	000	9	10/31	69	014 41 N	098 59 W	0	199	00/00/70	00/00/70	/ /
CNJ A2	CONNIE JEAN	6-10	1055	000	9	10/31	69	014 41 N	098 58 W	0	199	04/22/71	04/22/71	/ /
CNJ D1	CONNIE JEAN	6-10	1055	000	19	11/07	69	010 03 N	109 04 W	0	50	00/00/70	00/00/70	/ /
CNJ D2	CONNIE JEAN	6-11	1055	000	19	11/07	69	010 03 N	109 04 W	0	50	04/14/71	04/14/71	/ /
CNJ E1	CONNIE JEAN	6-11	1055	000	28	11/16	69	007 45 N	106 11 W	0	41	00/00/70	00/00/70	/ /
CNJ E2	CONNIE JEAN	6-11	1055	000	28	11/16	69	007 45 N	106 11 W	0	41	04/20/71	04/20/71	/ /
CRC A	CHRISTINA C	6-12	1074	000	25	05/24	75	012 20 N	089 10 W	0	64	07/02/75	07/02/75	11/14/77
CRC A1	CHRISTINA C	6-12	1074	000	31	05/28	75	012 30 N	092 15 W	0	155	07/01/75	07/01/75	11/14/77
CRC AD	CHRISTINA C	6-12	1076	320	8	07/31	75	020 08 N	106 04 W	51	154	08/29/75	08/29/75	10/26/77
CRC D	CHRISTINA C	6-13	1076	000		07/30	75	020 17 N	106 08 W	11	11	09/25/75	09/02/75	10/27/77
CUA	CUAUHTEMOC	6-13		202		01/02	73	004 40 N	081 20 W	52	193	/ /	02/27/73	/ /
CYV	CYVONES	6-13		206	BB	04/25	73	024 00 N	109 00 W	50	50	06/00/73	06/00/73	/ /
ECU A	SANTA FE	6-14		500		05/14	74	001 00 N	081 00 W	31	31	06/21/74	06/21/74	/ /
ECU B	MARIA EMILIA	6-14		501	BB	05/18	74	001 00 S	081 00 W	50	200	06/14/74	06/14/74	09/12/77
ECU C	MARIA DE LOU	6-14		502	BB	05/23	74	000 00 S	081 00 W	50	171	06/19/74	06/19/74	09/01/77

Code for SET column.
BB = Sample taken from one baitboat stop.
a Number = Indicates the purse-sein set from which the sample was taken.
C = Composite set. The sample was taken from more than one purse-sein set or baitboat stop.

SAMPLE CODE	VESSEL	APPENDIX PAGE	CRUISE NUMBER	G CODE	SET	MONTH DAY	YEAR	LAT	LOG	NUMBER MORPHS	NUMBER BLOODS	DATE ANALYZED EST	TEN	PGI
ECU D	RAMONCHO	6-15		503	C	07/08	74	001 40 S	080 38 W	50	160	07/22/74	07/22/74	09/21/77
ECU E	MARCIA	6-15		504	C	07/09	74	001 40 S	080 38 W	50	200	07/23/74	07/23/74	08/29/77
ECU F	APOLLO II	6-15		505	BB	09/25	74	000 40 N	081 08 W	50	188	10/21/74	10/21/74	12/15/77
ECU G	MARIA	6-16		506	C	10/02	74	000 04 N	081 13 W	50	200	10/18/74	10/18/74	08/16/77
ECU H	M EMILIA	6-16		507	C	10/28	74	001 35 S	081 30 W	50	199	/ /	11/12/74	12/13/77
ECU I	RIO JUBONES	6-16		508	C	10/29	74	001 34 S	081 40 W	50	200	/ /	11/14/74	12/16/77
ECU J	ROSA ISABEL	6-17		509	C	11/30	74	003 04 S	081 20 W	50	131	/ /	12/19/74	09/17/77
ECU JC		6-17		000	C	10/00	71	001 00 S	081 00 W	0	465	12/10/71	12/10/71	/ /
ECU K	PERLA DEL PA	6-17		510		12/01	74	002 30 S	081 16 W	50	200	/ /	12/20/74	01/10/78
ECU L	JACKIE	6-18		520	C	01/11	75	001 28 S	082 50 W	50	200	/ /	02/10/75	01/09/78
ECU M	MV OLIVIA	6-18		521		01/15	75	001 00 S	083 00 W	50	200	/ /	02/14/75	01/09/78
ECU N	DE LORES N	6-18		522		05/13	75	000 24 N	080 40 W	50	200	06/03/75	06/03/75	11/17/77
ECU O		6-19		000		05/17	75	000 00 N	081 00 W	0	76	06/05/75	06/05/75	06/25/78
ECU P	SAN PABLO	6-19		523	BB	05/29	75	000 00 N	081 00 W	50	200	08/25/75	08/25/75	10/25/77
ECU Q	PRINCESA PAC	6-19		524	1	08/01	75	000 12 S	083 15 W	50	200	/ /	08/27/75	10/20/77
ECU R	MARIELENA	6-20		525	BB	08/24	75	003 16 N	078 44 W	50	199	12/01/75	12/01/75	04/21/76
ECU S	RICARDITO	6-20		526	BB	09/19	75	000 15 N	081 53 W	50	200	12/03/75	12/03/75	04/23/76
ECU T	PIPO	6-20		527	BB	09/20	75	001 34 S	081 55 W	50	200	12/05/75	12/05/75	03/04/76
ECU U	LUCY	6-21		528	5	09/28	75	001 35 S	081 31 W	50	200	/ /	12/09/75	04/29/76
ECU V	LUCY	6-21		530	30	12/07	75	001 10 S	082 20 W	50	200	12/28/77	12/28/77	01/12/78
ECU W	LUCY	6-21		532	12	04/31	76	000 05 N	081 20 W	50	163	06/11/76	06/11/76	05/07/76
ECU X	LUCY	6-22		531	13	04/01	76	000 15 N	081 20 W	50	200	06/08/76	06/08/76	05/11/76
ECU XA		6-22		000		07/27	71	001 00 S	081 00 W	0	24	10/20/71	10/20/71	/ /
ECU XB		6-22		000		08/05	71	001 00 S	081 00 W	0	28	10/20/71	10/20/71	/ /
ECU XX		6-23		000		10/07	71	001 00 S	081 00 W	0	198	10/15/71	10/15/71	/ /
ECU Y	AMERICA	6-23		533	C	08/17	76	000 56 S	081 33 W	50	200	03/23/77	03/23/77	04/11/77
ECU Z	LUCY	6-23		534		09/17	76	001 25 S	081 40 W	50	145	03/28/77	03/28/77	04/15/77
ELS	ELSINORE	6-24		213		06/10	73	023 00 N	111 00 W	52	192	06/27/73	06/27/73	/ /
ETP	ENTERPRISE	6-24		215		07/26	73	007 40 N	082 55 W	50	100	/ /	/ /	/ /
GEM K1	GEMINI	6-24	1069	000		09/06	72	012 00 N	140 28 W	0	200	09/00/72	09/00/72	03/06/78
GEM K2	GEMINI	6-25	1069	000		09/06	72	012 00 N	140 28 W	0	200	03/17/78	03/17/78	03/06/78
GEM L	GEMINI	6-25	1069	160		08/18	72	012 15 N	133 05 W	0	200	09/14/72	09/14/72	02/29/78
GEM M	GEMINI	6-25	1069	161		09/27	72	009 03 N	141 32 W	0	218	12/26/72	12/26/72	09/12/77
GEM N	GEMINI	6-26	1069	000		11/20	72	003 14 S	081 40 W	0	210	/ /	01/05/73	09/07/77
GEM Z	GEMINI	6-26	1069	000	C	10/09	72	011 12 N	133 50 W	0	57	01/04/73	01/04/73	/ /
HST	HISTORIC	6-26		000		06/02	72	025 29 N	113 35 W	184	200	/ /	06/09/72	/ /
IDP	INDEPENDENCE	6-27		159	C	10/31	72	010 00 N	104 00 W	0	196	11/09/72	11/09/72	/ /
INV	INVADER	6-27	1067	153	BB	07/21	72	018 50 N	111 00 W	0	159	08/09/72	08/09/72	01/25/78
JHN F	PARAMOUNT	6-27		000		12/02	75	003 08 S	150 46 E	0	218	06/17/76	06/17/76	08/02/76
JMM AA	JM MARTINAC	6-28	1063	000	6	06/14	71	014 29 N	094 31 W	0	100	07/22/71	07/22/71	/ /
JMM BB	JM MARTINAC	6-28	1062	000	C	06/17	71	014 02 N	095 20 W	0	95	07/20/71	07/20/71	/ /
JMM CC	JM MARTINAC	6-28	1062	000	15	06/23	71	011 20 N	094 55 W	0	89	07/20/71	07/20/71	/ /
JMM DD	JM MARTINAC	6-29	1062	000	17	07/02	71	024 47 N	114 29 W	0	100	/ /	07/22/71	02/28/78
JMM EE	JM MARTINAC	6-29	1063	000		07/03	71	024 51 N	114 29 W	0	138	/ /	07/23/71	02/28/78
JNC	JEANETTE C	6-29		214		06/30	73	007 00 N	082 00 W	50	60	11/28/73	11/28/73	/ /
KRM KD	KAREN MARY	6-30	1078	305	BB	11/17	75	019 00 N	112 00 W	52	100	12/11/75	12/11/75	03/10/76
KRM KS	KAREN MARY	6-30	1078	000	BB	11/02	75	018 50 N	111 00 W	0	145	12/15/75	12/15/75	03/11/76

SAMPLE CODE	VESSEL	APPENDIX PAGE	CRUISE NUMBER	G CODE	SET	MONTH DAY	YEAR	LAT	LOG	NUMBER MORPHS	NUMBER BLOODS	DATE ANALYZED EST	TFN	PGI
MB	MARY BARBARA	6-30		203		03/08	73	005 05 N	082 15 W	52	133	04/30/73	04/30/73	/ /
ME B	MARY ELIZABE	6-31		000	7	08/05	76	000 07 S	141 00 E	0	200	04/01/77	04/01/77	04/25/77
ME E	MARY ELIZABE	6-31		000	11	08/13	76	001 04 S	138 50 E	0	199	03/30/77	03/30/77	04/21/77
ME F	MARY ELIZABE	6-31		000	19	08/21	76	001 45 N	139 14 E	0	112	05/03/77	05/03/77	05/16/77
MK B	MARY K	6-32	1079	314	BB	06/15	76	019 00 N	112 00 W	50	198	07/08/76	07/08/76	07/20/76
MK B2	MARY K	6-32	1082	321	BB	10/13	76	019 00 N	112 00 W	50	200	06/03/77	06/03/77	05/25/77
MK C	MARY K	6-32	1079	313	BB	06/14	76	019 20 N	110 50 W	24	24	/ /	/ /	07/26/76
MK E	MARY K	6-33	1079	315	BB	06/19	76	021 08 N	111 07 W	50	200	07/12/76	07/12/76	07/26/76
MK F	MARY K	6-33	1079	316	BB	06/20	76	022 42 N	111 12 W	50	121	07/15/76	07/15/76	07/29/76
MP A	MARCO POLO	6-33	1073	404		10/29	74	010 09 N	105 40 W	50	168	11/20/74	11/20/74	08/15/77
MP A1	MARCO POLO	6-34	1066	000	C	11/11	71	007 52 N	105 09 W	0	205	12/02/71	12/02/71	/ /
MP B	MARCO POLO	6-34	1073	405		11/07	74	009 30 N	108 49 W	50	54	11/25/74	11/25/74	/ /
MP BC	MARCO POLO	6-34	1066	000	C	11/19	71	009 00 N	105 00 W	0	311	11/29/71	11/29/71	/ /
MP C	MARCO POLO	6-35	1073	406		11/08	74	009 26 N	108 53 W	50	188	11/25/74	11/25/74	/ /
MP D1	MARCO POLO	6-35	1066	000	23	11/22	71	009 18 N	104 00 W	0	8	12/10/71	12/10/71	/ /
MP E1	MARCO POLO	6-35	1066	000	24	11/23	71	009 03 N	103 48 W	0	34	11/30/71	11/30/71	/ /
MP G	MARCO POLO	6-36	1072	400	6	04/18	74	012 35 N	093 30 W	52	152	06/28/74	06/28/74	08/19/77
MP I	MARCO POLO	6-36	1073	403		10/23	74	009 19 N	108 29 W	50	173	11/18/74	11/18/74	08/09/77
MP O	MARCO POLO	6-36	1072	401	19	04/25	74	012 53 N	093 02 W	50	199	06/25/74	06/25/74	08/23/77
MP P	MARCO POLO	6-37	1072	402	45	05/13	74	009 45 N	088 08 W	50	134	06/21/74	06/21/74	08/31/77
MRA H	MARY ANTOINE	6-37	1068	156	1	07/28	72	008 30 N	118 55 W	0	200	08/31/72	08/31/72	08/12/77
MRA I	MARY ANTOINE	6-37	1068	157	20	08/14	72	018 15 N	110 30 W	0	204	08/28/72	08/28/72	08/09/77
MRA X	MARY ANTOINE	6-38	1068	000		08/04	72	009 35 N	116 50 W	0	176	08/31/72	08/31/72	08/25/77
MRC B1	MARY CARMEN	6-38	1054	000	BB	10/29	69	016 20 N	099 27 W	0	16	00/00/70	00/00/70	/ /
MRC B2	MARY CARMEN	6-38	1054	000	BB	10/29	69	016 20 N	099 27 W	0	16	04/22/71	04/22/71	/ /
MRC C1	MARY CARMEN	6-39	1054	000	BB	11/06	69	009 00 N	109 00 W	0	100	00/00/70	00/00/70	/ /
MRC C2	MARY CARMEN	6-39	1054	000	BB	11/06	69	009 00 N	109 00 W	0	100	04/21/71	04/21/71	/ /
MRQ 1	TANUI	6-39		000	C	09/00	77	009 00 S	140 00 W	0	35	03/21/78	03/21/78	01/29/78
MRQ 2	MARY K	6-40		000	C	03/00	78	009 00 S	140 00 W	0	70	05/16/78	05/16/78	06/16/78
MRT	MARIETTA	6-40	1071	000	11	10/16	73	008 35 N	100 13 W	70	70	11/28/73	11/28/73	/ /
MRT L1	MARIETTA	6-40	1059	000	3	11/19	70	009 34 N	107 12 W	0	325	01/18/71	01/18/71	11/21/77
MRT L2	MARIETTA	6-41	1059	000	4	11/16	70	009 34 N	107 12 W	0	168	01/18/71	10/18/71	/ /
MRT M1	MARIETTA	6-41	1059	000	5	11/08	70	009 45 N	106 38 W	0	131	01/25/71	01/25/71	/ /
MRT M2	MARIETTA	6-41	1059	000	6	11/09	70	009 40 N	106 08 W	0	18	01/25/71	01/25/71	/ /
MRT N	MARIETTA	6-42	1059	000	7	11/09	70	009 40 N	106 08 W	0	154	12/28/70	12/28/70	/ /
MRT P	MARIETTA	6-42	1059	000	10	11/14	70	014 08 N	103 50 W	0	93	12/28/70	12/28/70	12/02/77
MRT Q	MARIETTA	6-42	1059	000	11	11/19	70	008 35 N	101 35 W	0	268	12/15/70	12/15/70	11/22/77
MRT R1	MARIETTA	6-43	1059	000	12	11/19	70	009 00 N	101 50 W	0	69	12/16/70	12/16/70	11/29/77
MRT R2	MARIETTA	6-43	1059	000	13	11/20	70	009 40 N	101 58 W	0	174	12/21/70	12/21/70	11/30/77
MRT R3	MARIETTA	6-43	1059	000	14	11/20	70	009 43 N	102 14 W	0	140	12/15/70	12/15/70	11/01/77
MRT R4	MARIETTA	6-44	1059	000	15	11/21	70	010 11 N	102 06 W	0	16	01/05/71	01/05/71	11/03/77
MRT R5	MARIETTA	6-44	1059	000	16	11/21	70	010 00 N	102 17 W	0	32	01/05/71	01/05/71	11/03/77
MRT S	MARIETTA	6-44	1059	000	2	10/30	70	016 10 N	110 37 W	0	155	01/13/71	01/13/71	11/18/77
MRT T	MARIETTA	6-45	1059	000		11/27	70	015 35 N	104 17 W	0	66	01/27/71	01/27/71	10/06/77
MRT U	MARIETTA	6-45	1059	000	20	11/29	70	016 41 N	107 21 W	0	126	01/05/71	01/05/71	10/07/77
MRT V	MARIETTA	6-45	1059	000	21	11/30	70	019 35 N	107 18 W	0	220	01/05/71	01/05/71	10/07/77

SAMPLE CODE	VESSEL	APPENDIX PAGE	CRUISE NUMBER	G CODE	SET	MONTH DAY	YEAR	LAT	LOG	NUMBER MORPHS	NUMBER BLOODS	DATE ANALYZED EST	TFN	PGI
MRT W	MARIETTA	6-46	1059	000	22	12/02	70	022 15 N	109 33 W	0	23	01/13/71	01/13/71	/ /
MRT XN	MARIETTA	6-46	1059	000	8	11/10	70	009 26 N	105 46 W	0	37	01/25/71	01/25/71	/ /
PNG 1	KAISEI MARU	6-46		000		10/28	75	003 28 S	151 05 E	0	20	12/09/75	12/09/75	03/15/76
PNG 2		6-47		000	C	11/11	75	011 00 S	151 00 E	0	30	01/23/76	01/23/76	03/15/76
PTW 10	PACIFIC TRDW	6-47	1062	000	12	04/29	71	006 57 N	096 50 W	0	107	06/17/71	06/17/71	/ /
PTW 10	PACIFIC TRDW	6-47	1062	000	C	04/29	71			0	188	/ /	/ /	09/21/77
PTW 12	PACIFIC TRDW	6-47	1062	000	13	04/29	71	006 58 N	092 53 W	0	89	06/17/71	06/17/71	/ /
PTW 27	PACIFIC TRDW	6-48	1062	000	27	05/07	71	007 38 N	092 25 W	0	200	06/30/71	06/30/71	09/22/77
PTW 37	PACIFIC TRDW	6-48	1062	000	37	05/17	71	008 47 N	088 16 W	0	201	06/24/71	06/24/71	09/23/77
PTW 42	PACIFIC TRDW	6-48	1062	000	42	05/20	71	009 45 N	085 40 W	0	198	06/28/71	06/28/71	09/28/77
PTW 45	PACIFIC TRDW	6-49	1062	000	45	05/22	71	009 15 N	085 10 W	0	199	07/02/71	07/02/71	10/03/77
PTW 52	PACIFIC TRDW	6-49	1062	000	52	05/29	71	015 19 N	096 30 W	0	134	06/22/71	06/22/71	10/24/77
SEP	SEA PREME	6-49		204		03/31	73	006 30 N	078 35 W	50	99	05/02/73	05/02/73	/ /
SEQ	SEA QUEST	6-50		201	C	01/21	73	007 00 N	105 00 W	50	107	03/01/73	03/01/73	/ /
SNC A	SANDRA C	6-50	1080	420	8	10/14	76	015 05 N	102 12 W	50	200	06/06/77	06/06/77	06/17/77
SNC B	SANDRA C	6-50	1080	421	23	10/28	76	009 48 N	105 15 W	50	200	06/08/77	06/08/77	06/20/77
SNC C	SANDRA C	6-51	1080	422	33	11/09	76	013 24 N	108 04 W	50	130	06/15/77	06/15/77	06/23/77
SNC D	SANDRA C	6-51	1080	423	41	11/19	76	010 00 N	106 45 W	50	200	06/14/77	06/14/77	06/21/77
SNC E	SANDRA C	6-51	1080	424	45	11/22	76	006 45 N	106 15 W	50	130	06/29/77	06/29/77	06/27/77
SNC F	SANDRA C	6-52	1080	425	56	11/28	76	013 30 N	107 05 W	50	200	06/30/77	06/30/77	06/24/77
SNL A	SAN LUCAS	6-52		300	BB	04/04	74	021 00 N	109 00 W	50	130	06/26/74	06/26/74	/ /
SNL AB	SAN LUCAS	6-52		000	BB	04/04	74	021 00 N	109 00 W	0	96	06/11/74	06/11/74	03/10/78
SNL B	SAN LUCAS	6-53		301	BB	04/04	74	021 00 N	109 00 W	50	65	06/11/74	06/11/74	03/10/78
SNL C	SAN LUCAS	6-53		302	BB	04/07	74	021 55 N	109 55 W	50	136	06/12/74	06/12/74	03/01/78
STA	SANTA ANITA	6-53	1070	000	BB	06/26	73	022 05 N	111 10 W	80	79	07/12/73	07/12/73	/ /
STI	SANTA ISABEL	6-54		200		01/17	73	019 00 N	112 00 W	51	200	/ /	01/31/73	/ /
STS 1	SOUTH SEAS	6-54		163		12/08	72	027 00 N	115 00 W	50	192	/ /	01/17/73	/ /
STS 2	SOUTH SEAS	6-54		164	C	01/16	73	016 52 N	117 32 W	22	22	/ /	01/17/73	/ /
TAR A	TAURUS	6-55	1075	306	BB	06/27	75	020 35 N	109 49 W	50	155	08/05/75	08/05/75	10/27/77
TAR C	TAURUS	6-55	1075	307	BB	07/03	75	019 20 N	110 50 W	41	41	08/07/75	08/07/75	/ /
TAR D	TAURUS	6-55	1075	308	BB	07/07	75	023 58 N	113 58 W	50	199	08/07/75	08/07/75	11/04/77
TAR E	TAURUS	6-56	1075	309	BB	07/10	75	024 03 N	113 43 W	50	200	08/13/75	08/13/75	10/28/77
TAR E1	TAURUS	6-56	1075	000	BB	07/11	75	023 51 N	113 50 W	0	61	/ /	08/14/75	11/07/77
TAR F	TAURUS	6-56	1075	310	BB	07/12	75	024 06 N	113 29 W	50	130	/ /	08/18/75	11/09/77
TAR H	TAURUS	6-57	1075	311	BB	07/18	75	019 00 N	112 00 W	50	74	/ /	08/20/75	/ /
TAR I	TAURUS	6-57	1075	312	BB	07/21	75	022 03 N	110 20 W	50	200	08/20/75	08/20/75	11/08/77
TRD	TRINIDAD	6-57		207		04/13	73	006 42 N	081 22 W	50	198	07/02/73	07/02/73	/ /
XX		6-58		000	C	07/18	72	002 05 S	081 00 W	0	349	07/29/72	07/29/72	01/26/78
XXY		6-58		000		07/18	72	002 05 S	081 00 W	51	51	07/27/72	07/27/72	01/26/78
XXZ		6-58		000	C	07/18	72	002 05 S	081 00 W	51	51	07/27/72	07/27/71	01/28/78
ZP A1	ZAPATA PATHF	6-59		000	5	08/02	76	002 04 N	152 46 E	0	63	05/04/77	05/04/77	05/17/77
ZP A2	ZAPATA PATHF	6-59		000	8	08/16	76	000 28 N	139 23 E	0	130	05/04/77	05/04/77	05/17/77
ZP D1	ZAPATA PATHF	6-59		000	15	09/18	76	002 31 S	141 42 E	0	56	05/06/77	05/06/77	05/18/77
ZP D2	ZAPATA PATHF	6-60		000	16	09/19	76	002 03 S	141 04 E	0	112	05/09/77	05/09/77	05/19/77
ZP H	ZAPATA PATHF	6-60		000	25	10/09	76	003 38 N	148 43 E	0	199	05/10/77	05/10/77	05/20/77
ZP I	ZAPATA PATHF	6-60		000	27	10/12	76	001 45 N	149 10 E	0	109	05/13/77	10/13/77	15/23/77
ZP J	ZAPATA PATHF	6-61		000	29	10/16	76	002 15 N	154 49 E	0	127	06/02/77	06/02/77	05/24/77

APPENDIX 4.

Skipjack sample index (list of skipjack samples).

SAMPLE CODE	VESSEL	APPENDIX PAGE	CRUISE NUMBER	G CODE	SET	MONTH DAY	YEAR	LAT	LOG	NUMBER MORPHS	NUMBER BLOODS	DATE EST	ANALYZED TFN
AP A	APOLLO	7-1		000		09/18	76	002 05 S	141 22 E	0	172	03/14/77	03/14/77
CRC C	CHRISTINA C	0-0	1077	000		10/29	75	004 59 N	103 28 W	0	20		
EC B	LUCY	7-1		000	14	09/30	75	001 25 S	081 10 W	50	200	01/06/76	01/06/76
EC C	LUCY	7-1		000	6	11/17	75	002 05 S	082 30 W	50	200	09/09/76	09/09/76
EC D	LUCY	7-2		000	14	11/19	75	002 05 S	081 55 W	50	200	09/13/76	09/13/76
EC E	LUCY	7-2		000	4	03/27	76	000 45 N	081 02 W	50	200	02/10/77	01/10/77
EC F	LUCY	7-2		000	7	03/28	76	000 40 N	081 05 W	50	200	02/15/77	02/15/77
EC G	JACKIE	7-3		000	BB	06/21	76	000 19 S	081 48 W	50	200	09/17/76	09/17/76
EC H	LUCY	7-3		000		09/09	76	000 50 S	081 20 W	50	200	02/08/77	02/08/77
EC I	VIVIENNE II	7-3		000	BB	04/12	77	003 30 N	078 12 W	50	200	08/02/77	08/02/77
JOHN F	PARAMOUNT	7-4		000		04/19	76	002 00 S	150 30 E	0	137	06/21/76	06/21/76
KA	KAREN MARY	7-4	1078	000	BB	10/30	75	024 12 N	112 12 W	52	153	01/08/76	01/08/76
KB	KAREN MARY	7-4	1078	000	BB	11/01	75	019 00 N	112 00 W	52	162	01/13/76	01/13/76
KC	KAREN MARY	7-5	1078	000	BB	11/17	75	019 00 N	112 00 W	0	136	01/15/76	10/15/76
ME A	MARY ELIZABE	7-5		000	6	08/04	76	000 00 S	140 58 E	0	200	01/26/77	01/26/77
ME D	MARY ELIZABE	7-5		000	9	08/09	76	003 14 S	145 10 E	0	198	02/01/77	02/01/77
ME G	MARY ELIZABE	7-6		000	21	09/11	76	004 30 S	150 55 E	0	100	02/04/77	02/04/77
MK A1	MARY K	7-6	1079	000	BB	06/09	76	021 18 N	111 03 W	50	200	06/28/76	06/28/76
MK A2	MARY K	7-6	1082	000	BB	10/07	76	026 41 N	114 00 W	50	198	01/20/77	01/20/77
MK C	MARY K	7-7	1082	000	BB	10/14	76	019 00 N	112 00 W	50	200	01/24/77	01/24/77
MK D	MARY K	7-7	1079	000	BB	06/17	76	021 16 N	111 04 W	50	199	07/01/76	07/01/76
MRQ	MARY K	7-7	1079	000	C	03/00	78	010 00 S	140 00 W	0	93	05/17/78	05/17/78
NZ A	KERRY M	7-8		000	C	02/00	76	034 00 S	173 00 E	0	199	04/01/76	04/01/76
NZ B	KERRY M	7-8		000	C	02/00	76	034 00 S	173 00 E	0	199	04/01/76	04/01/76
NZ00 1		7-8		000		12/00	75	035 00 S	173 00 E	0	126	04/15/76	04/15/76
NZ00 2		7-9		000		12/00	75	035 00 S	173 00 E	0	70	04/15/76	04/15/76
NZ00 3		7-9		000		12/00	75	035 00 S	173 00 E	0	30	04/15/76	04/15/76
PNG A	MV SHINEI M3	7-9		000	BB	10/26	75	003 55 S	151 21 E	0	147	12/16/75	12/16/75
PNG B	MV TAISIN M6	7-10		000	BB	10/27	75	003 55 S	151 15 E	0	163	12/18/75	12/18/75
PNG NH		7-10		000		06/18	76	002 45 S	150 10 E	40	180	03/21/77	03/21/77
PNG Y		7-10		000		11/13	75	011 52 S	154 22 E	0	148	01/20/76	01/20/76
PNG Z		7-11		000		11/12	75	011 18 S	150 52 E	0	187	01/21/76	01/21/76
S218		7-11		000		03/06	76	037 40 S	177 00 E	0	124	04/06/76	04/06/76
S223		7-11		000		03/08	76	037 40 S	177 00 E	0	200	04/13/76	04/13/76
SC SG	SANDRA C	7-12	1080	000	58	12/01	76	009 36 N	103 30 W	50	201	01/04/77	01/04/77
TAR B1	TAURUS	7-12	1075	000	BB	07/01	75	020 05 N	109 08 W	50	157	09/02/75	09/02/75
TAR B2	TAURUS	7-12	1075	000	BB	07/01	75	020 05 N	109 08 W	50	157	09/02/75	09/02/75
TAR G	TAURUS	7-13	1075	000	BB	07/12	75	024 15 N	113 28 W	0	21	09/04/75	09/04/75
TAR G1	TAURUS	7-13	1075	000	BB	07/12	75	024 15 N	113 28 W	0	21	09/04/75	09/04/75
TAR G2	TAURUS	7-13	1075	000	BB	07/20	75	021 26 N	110 47 W	50	200	09/04/75	09/04/75
TAR G3	TAURUS	7-14	1075	000	BB	07/20	75	021 26 N	110 47 W	50	200	09/04/75	09/04/75

Code for SET column.

BB = Sample taken from one baitboat stop.

a Number = Indicates the purse-sein set from which the sample was taken.

C = Composite set. The sample was taken from more than one purse-sein set or baitboat stop.

SAMPLE CODE	VESSEL	APPENDIX PAGE	CRUISE NUMBER	CRUISE CODE	G SET	MONTH DAY	YEAR	LAT	LOG	NUMBER MORPHS	NUMBER BLOODS	DATE EST	ANALYZED TFN
ZP B	ZAPATA PATHF	7-14		000	6	08/07	76	002 00 N	152 00 E	0	198	03/02/77	03/02/77
ZP C	ZAPATA PATHF	7-14		000	11	08/31	76	006 10 N	123 15 E	0	189	13/08/77	03/08/77
ZP EA	ZAPATA PATHF	7-15		000	19	09/23	76	001 16 S	139 57 E	0	36	02/17/77	02/17/77
ZP EB	ZAPATA PATHF	7-15		000	22	09/29	76	003 13 N	149 00 E	0	94	02/17/77	02/17/77
ZP F	ZAPATA PATHF	7-15		000	21	09/29	76	003 01 N	148 57 E	0	200	02/23/77	02/23/77
ZP G	ZAPATA PATHF	7-16		000	24	10/08	76	003 21 N	148 19 E	0	201	02/25/77	02/25/77

APPENDIX 5.

Memorandum from Robert C. Frances to John R. Calaprice regarding Yellowfin morphometrics.

To: John Calaprice
From: Bob Francis
Subject: 1974-1976 Yellowfin Tuna Morphometrics

This project has had two main objectives. The first was to gather together and organize the yellowfin tuna morphometrics data taken on fresh fish during the years 1974, 1975 and 1976. The second was to examine the statistical method of stepwise canonical analysis (sometimes referred to as stepwise discriminant analysis) as to its basic discriminatory properties. In particular I was interested in determining what the effect of different fork length (FL) distributions was on the discriminatory properties of the statistical method. My basic condition is that in order to use this method samples should be standardized to a common fork length before being subjected to the canonical analysis. If this is impossible (which it very well may be, [as] I did not investigate the presence or absence of allometry in the samples) then some other statistical technique should be used.

Table 1 gives a listing of all pertinent information about the samples on the master file which I left in La Jolla with you. As you can see there are several samples for which I have morphometrics which are not identifiable in Sharp's [1978] table 2 (307, 311, 313, 403, 405, 500, 550) [Sample 550 is a skipjack sample, W.P. Kane]. All 300 samples are from the northern area (N of 15 N), all 400 samples from the middle area (5 N to 15 N) and all 500 samples are from the southern area (S of 5 N). As I told you when I was in La Jolla, Gary [Sharp] mentions several morphometric samples in his paper that I cannot find in Table 2 (e.g. San Lucas A - I would guess that to be G300 although I cannot be sure [confirmed by W.P. Kane].

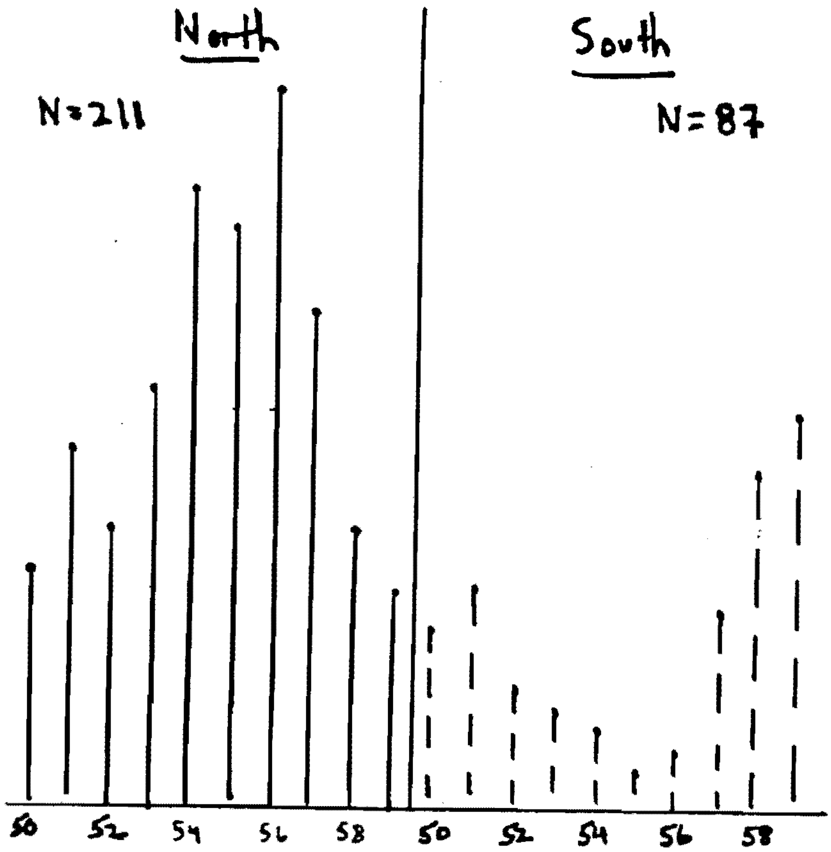
In order to investigate some of the properties of stepwise canonical analysis [computer program] (BMD 07M) [Dixon 1974] as they relate to the underlying size distributions of the animals in the sample, I proceeded in two directions.

First I compared two <u>simulated</u> groups of animals, drawn from the <u>same</u> population, with the only difference between them being the distributions of total length and the sample sizes. The idea arose as a result of comparing the pooled 1975 samples ranging from 500-599 mm between the north and south areas. What arose was the following classification table:

Number of Cases Classified into Groups

		Into N	Into S
From	N	184	27
	S	14	73

Thus 13% of the N animals were misclassified and 16% of the S animals were misclassified. The underlying FL distribution of the two groups was as follows:



The basic question that I hoped to answer was; how much of the apparent difference between the two samples was due to the different underlying FL distributions? I therefore wrote a program which would, assuming that the N and S samples were taken from the same underlying population (null hypothesis):

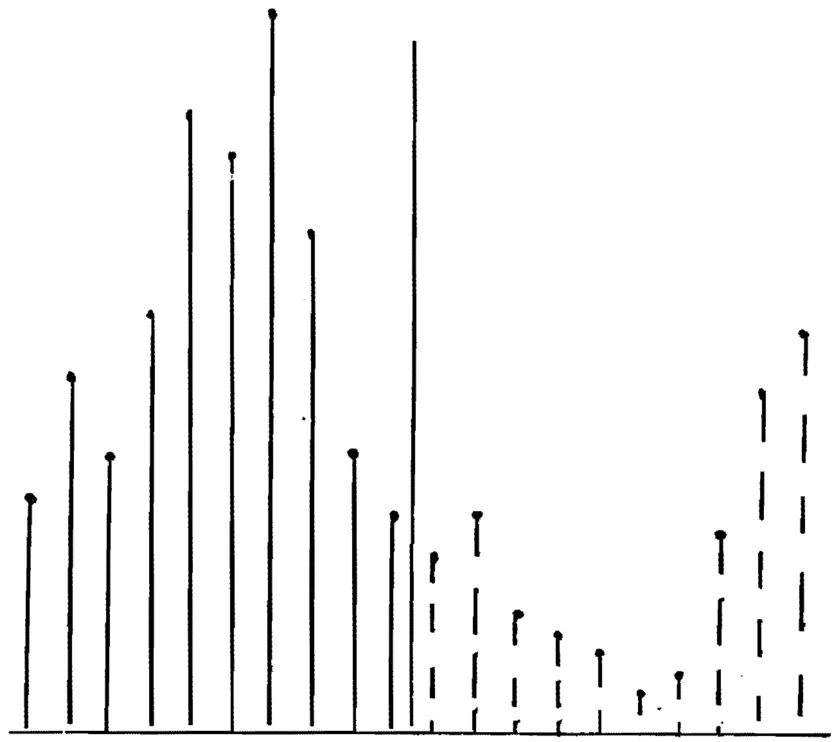
a) Estimate the mean value of the 7 other morphometrics (S-1D, S-2D, S-A, HL, 1D-2D, 1D-A, 2D-A) for each 1-cm FL class from 50 to 59 cm.

b) Estimate the <u>within-class</u> variance-covariance matrix for the 7 other morphometrics

c) Generate multivariate normal random vectors of morphometrics with the desired distributions of FL.

The following cases were simulated and compared using BMD 07M. Remember that the only differences between the N and S samples are the <u>sample sizes</u> and <u>distributions of FL</u>:

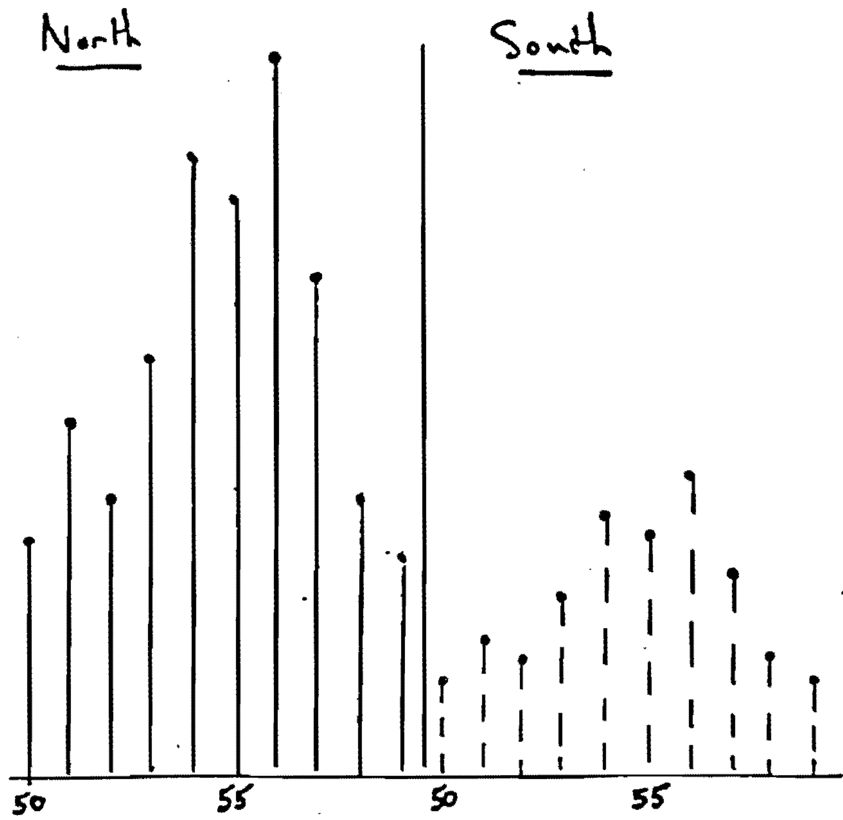
a) Observed FL distributions



Number of Cases Classified into Groups

	Into N	Into S
N	123	88
S	43	44

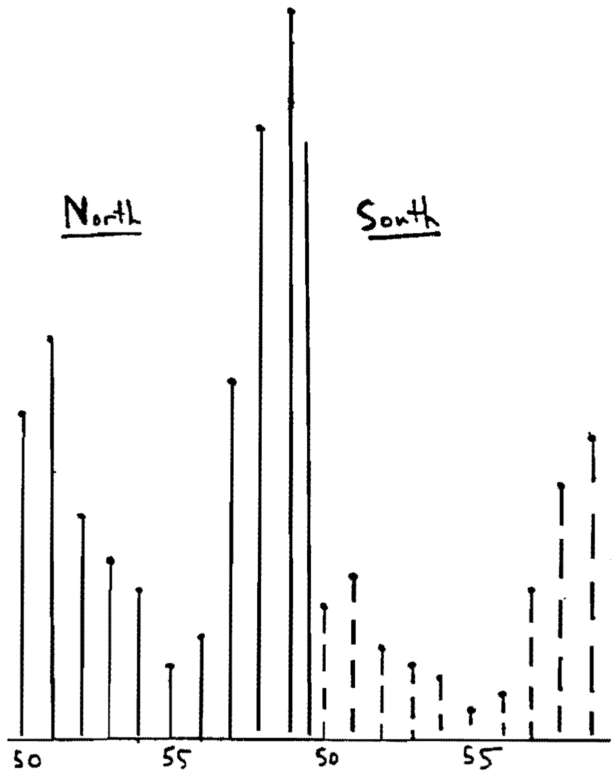
b) Same relative FL distn. for S as for N



Number of Cases Classified Into Groups

From	Into N	Into S
N	118	93
S	37	51

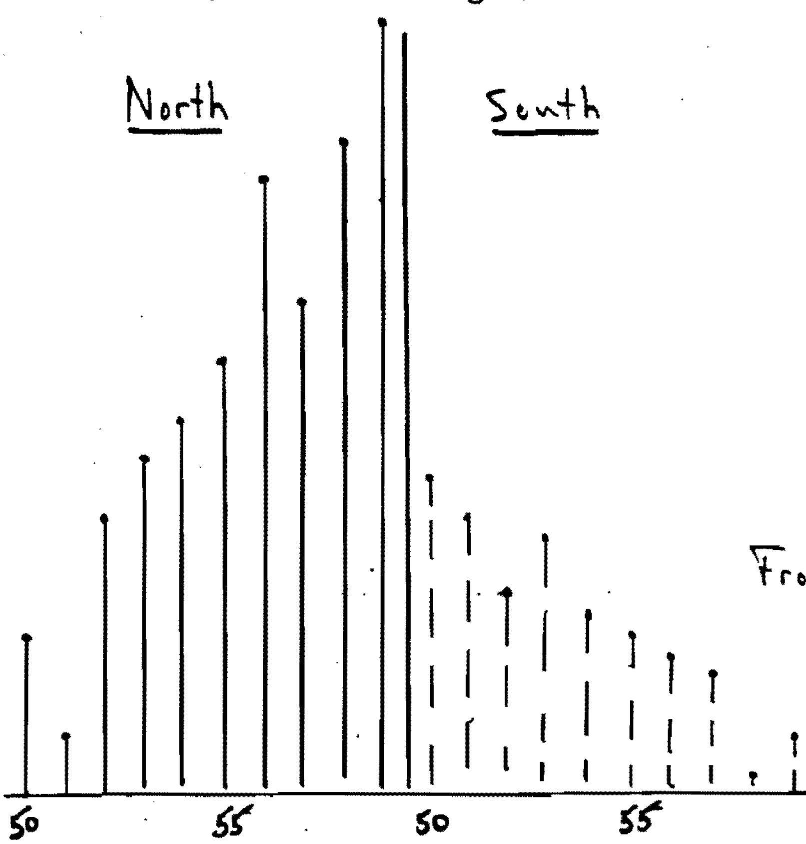
c) Same relative FL distr. for N as for S



Into

		N	S
From	N	116	96
	S	33	54

d) N skewed to left, S skewed to right.



Classified.

Into

		N	S
From.	N	152	59
	S	23	64

It is quite obvious from this analysis that even if samples are taken from as small as 10 cm. fork length range, the actual size distributions of the samples within that range can have a significant impact on the resolution of the canonical analysis.

Finally a second set of canonical analyses were made with FL excluded from the set of variables. Virtually the same results were obtained.

In the next set of analyses I took all samples that had <u>at least</u> 20 animals in the 10 cm. FL ranges --50-59 cm, 60-69 cm, 70-79 cm --and classified them within those ranges using stepwise canonical analyses (BMD 07M). For each sample I then examined the animals that were <u>not</u> classified back into that sample to see if:

a) they tended to be classified into samples from the same region (N=North, M=Middle, S=South)

b) they tended to be classified into samples with similar mean fork lengths.

In order to examine b) above samples were categorized as S=<u>small</u> if their mean fork length occurred in the lower third of the 10 cm. range, M=<u>medium</u> if their mean fork length occurred in the middle third of the 10 cm. range, and L=<u>large</u> if their mean fork length occurred in the upper third of the 10 cm. range. The observed classification frequencies are compared with those that one would expect to occur if classification was at random.

Tables 2 and 3 show the results of this analysis for samples with at least 20 animals in the fork length range of 50-59 cm. Thus if <u>misclassifications</u> were made at random into the 18 samples being compared, one would expect 125 (9/17 x (136+30+71)) of the northern animals to be misclassified into the north, 30 of the northern animals to be misclassified into the middle and 71 of the northern animals to be misclassified into the south (Table 2), and one would expect 14 (3/17 x (38+36+3)) of the <u>small</u> animals to be misclassified into S, 54 of the small animals to be misclassified into M and 9 of the small animals to be misclassified into L [Table 3]. Looking at the Chi square comparisons of observed from expected frequencies under random misclassifications, it appears that classification was, on the average, more strongly influenced by <u>size</u> than by <u>area</u> in the case of animals ranging from 50-59 cm. fork length.

Tables 4 and 5 show the results of similar analyses for samples with at least 20 animals in the fork length range of 60-69 cm. Again there is no indication that misclassifications were more strongly influenced by area than by size.

Tables 6 and 7 show similar results for samples with at least 20 animals in the fork length range of 70-79 cm. The only difference is that the <u>small</u> (S) category contains subsamples whose mean fork length is less than 75 cm. and the <u>large</u> (L) category contains subsamples whose mean fork length is greater than 75 cm. Again size seems to have a stronger influence on classification than area.

These tables (2-7) only give an indication of the relative importance of size and area in classification of yellowfin by stepwise canonical analysis on morphometrics. Obviously size and area are confounded and no attempt, here, was made to partition their effects independently. However, I think the trend is clear. It is quite obvious that the size distribution of uncorrected samples does have an effect on the classification procedure. And it appears to have a stronger effect than the area in which the animals were caught. If northern, middle or southern animals tended to show a distinctive "shape" or relative growth pattern, then one would expect animals caught in one of those areas to have a greater chance of being misclassified into another sample from that area than into a sample from another area.

My overall feeling, after manipulating these data for a while, is that stepwise canonical analysis on uncorrected morphometrics presents more questions than answers. If I were to seriously delve into the morphometrics on a long-term basis I would look for other avenues of analysis. I think that this could provide a very good project for an M.S. or Ph.D. student with interests in biostatistics.

TABLE 1.

Sample	Sharp's Table 2	Date	Location	N	FL Range (cm)
G300	San Lucas B?	4-04-74 [1]		50	46-62
G301	San Lucas?	4-04-74 [2]		49	49-60
G302	San Lucas C	4-07-74		49	51-60
G306	Taurus A	6-27-74 [3]		50	45-77
G307	[Taurus C]	7-03-75		41	73-87
G308	Taurus D	7-07-75		50	48-59
G309	Taurus E	7-10-75		49	50-60
G310	Taurus F	7-12-75		50	50-78
G311	[Taurus H]	7-18-75		50	69-99
G312	Taurus I	7-21-75		50	47-88
G320	Christina C-A	7-30-75 [4]		54	77-95
G305	K D	11-17-75		51	46-69
G313	[MKC]	6-14-76		24	59-76
G314	MKB	6-15-76		50	48-77
G315	MKE	6-19-76		50	42-68
G316	MKF	6-20-76		50	48-69
G321	Mary K B2	10-13-76		49	43-74
G400	Marco Polo G	4-18-74		50	53-67
G401	Marco Polo O	4-25-74		50	56-66
G402	Marco Polo P	5-13-74		50	56-66
G403	[Marco Polo I]	10-23-74		50	59-79
G404	Marco Polo A	10-29-74		50	70-91
G405	[Marco Polo B]	11-07-74		50	65-91
G406	Marco Polo I	11-08-74 [5]		50	60-78
G420	Sandra C - A	10-14-76		49	79-103
G421	Sandra C B	10-28-76		49	59-82
G422	Sandra C C	11-09-76		50	44-63
G423	Sandra C D	11-19-76		50	66-85
G424	Sandra C E	11-22-76		50	65-87
G425	Sandra C F	11-28-76		50	43-63
G500	[A]	5-14-74		28	80-110
G501	B	5-18-74		50	56-77
G502	C	5-23-74		50	53-59
G503	D	7-08-74		47	57-68
G504	E	7-09-74		48	58-68
G505	F	9-25-74		46	54-70
G506	G	10-02-74		49	63-71
G507	H	10-28-74		50	60-73
G508	I	10-29-74		50	56-71
G509	J	12-01-74 [6]		49	67-79
G510	K	12-10-74 [7]		50	63-78

TABLE 1. (continued)

G520	L	1-11-75	50	69-81
G521	M	1-15-75	50	63-79
G522	N	5-13-75	50	53-63
G523	P	5-29-75	50	51-65
G524	Q	8-01-75	50	101-124
G525	R	8-24-75	50	35-45
G526	S	9-19-75	50	40-49
G527	T	9-20-75	5	41-51
G528	U	9-28-75	49	87-109.7
G530	V	12-07-75	50	44-55
G532	W	3-31-76	50	52-58
G531	X	4-01-76	50	53-59
G550	[G]	6-21-76 [8]	50	39-53
G533	Y	8-17-76	50	59-71
G534	Z	9-17-76	50	63-72

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[1] true sample name San Lucas A
[2] true sample name San Lucas B
[3] date should be 6-27-75
[4] true sample name Christina C-AD, date should be 7-31-75
[5] true sample name Marco Polo C
[6] date should be 11-30-74
[7] date should be 12-01-74
[8] This sample is a skipjack sample, not a yellowfin sample.
[ ] data supplied by William P. Kane

TABLE 2. 50-59 cm. FL classified by area.

Area	Sample	Classified into itself	Misclassified into N	Misclassified into M	Misclassified into S	X^2
N	300	20	8	10	9	
	301	18	13	5	11	
	302	9	15	4	20	
	306	9	14	4	5	
	308	27	20	1	1	
	309	20	26	1	1	
	310	17	13	1	3	
	305	15	7	0	10	
	316	9	11	1	4	
	321	15	9	3	7	
	Total N	159	136	30	71	
	Expected under random misclassification		125	28	84	3.12
M	422	19	6	0	16	
	425	14	9	1	11	
	Total M	33	15	1	27	
	Expected under random misclassification		25	3	15	14.93
S	502	20	16	0	14	
	522	21	7	0	3	
	523	13	3	1	10	
	530	17	4	5	0	
	532	9	18	3	20	
	531	10	20	6	14	
	Total S	90	68	15	61	
	Expected under random misclassification		85	17	42	12.23
					TOTAL $X^2(5)$	30.28

TABLE 3. 50-59 cm. FL classified by size.

Size	Sample	Classified into itself	Misclassified into S	Misclassified into M	Misclassified into L	X^2
Small	306	9	4	17	0	
50-53 cm	530	17	6	3	0	
mean FL.	422	19	16	8	2	
	425	14	12	8	1	
	Total S	59	38	36	3	
	Expected under random misclassification		14	54	9	51.14
Medium	300	20	13	13	1	
54-56 cm	301	18	7	10	5	
Mean FL.	302	9	6	22	8	
	502	20	0	21	9	
	308	27	3	18	1	
	309	20	3	24	1	
	310	17	1	14	2	
	305	15	0	9	5	
	316	9	1	12	3	
	321	15	4	13	2	
	532	9	6	22	13	
	531	10	9	27	4	
	Total M	189	53	205	54	
	Expected under random misclassification		73	202	37	13.33
Large	522	21	0	10	0	
57-59	523	13	2	6	6	
Mean FL						
	Total L	34	2	16	6	
	Expected under random misclassification		6	17	1	27.73
					TOTAL $X^2(5)$	92.20

TABLE 4. 60-69 cm. FL classified by area.

Area	Sample	Classified into itself	Classified into N	M	S	X^2
N	305	14	0	0	6	
	314	6	6	3	18	
	316	12	3	4	5	
	Total N	32	9	7	29	
	Expected under random misclassification		5	11	29	4.65
M	400	14	2	18	3	
	401	14	0	18	3	
	402	16	1	10	11	
	421	10	3	0	11	
	Total M	54	6	46	28	
	Expected under random misclassification		14	14	52	88.79
S	500	7	3	1	11	
	503	14	1	10	17	
	504	14	2	10	18	
	505	10	5	3	23	
	506	30	1	2	13	
	507	9	7	3	26	
	508	12	7	8	20	
	510	11	4	0	12	
	523	16	2	1	4	
	533	29	1	2	16	
	534	23	6	1	11	
	Total S	175	39	41	171	
	Expected under random misclassification		44	59	148	9.63
					TOTAL $X^2(5)$	103.07

TABLE 5. 60-69 cm. FL classified by size.

Size	Sample	Classified into itself	Misclassified into S	Misclassified into M	Misclassified into L	X^2
Small	400	14	23	1	0	
60-63 cm.	401	14	21	1	3	
Mean FL.	402	16	21	2	0	
	503	14	12	10	0	
	504	14	18	9	3	
	508	12	16	19	0	
	305	14	3	2	1	
	523	16	3	3	1	
	Total S	114	117	47	8	
	Expected under random misclassification		71	71	30	54.05
Medium	500	7	7	4	4	
64-66 cm.	505	10	10	12	10	
mean FL.	507	9	21	11	4	
	314	6	3	12	9	
	316	12	3	7	2	
	421	10	6	3	3	
	533	29	2	6	11	
	Total M	83	52	55	43	
	Expected under random misclassification		71	53	26	16.28
Large	506	30	0	12	4	
67-69 cm	510	11	1	9	6	
Mean FL.	534	23	3	12	3	
	Total L	64	4	33	13	
	Expected under random misclassification		24	21	6	31.69
					TOTAL $X^2(5)$	102.02

TABLE 6. 70-79 cm. FL classified by area.

Area	Sample	Classified into itself	Misclassified into M	Misclassified into S	X^2
M	403	6	15	20	
	404	19	4	3	
	405	11	15	8	
	406	13	10	12	
	423	10	13	7	
	424	8	9	5	
	Total M	67	66	55	
	Expected under random misclassification		60.5	60.5	1.00
S	500	11	6	3	
	509	2	23	17	
	510	7	9	7	
	520	15	15	16	
	521	9	22	17	
	Total S	44	75	60	
	Expected under random misclassification		81	54	1.11
				TOTAL $X^2(1)$	2.11

TABLE 7. 70-79 cm. FL classified by size.

Size	Sample	Classified into itself	Misclassified into S	L	X^2
Small	403	6	26	9	
<75 cm	405	11	12	11	
Mean FL.	406	13	15	7	
	500	11	5	4	
	509	2	34	6	
	510	7	12	4	
	520	15	25	6	
	521	9	26	13	
	Total S	74	155	60	
	Expected under random misclassification		150.5	64.5	0.45
Large	404	19	6	1	
>75 cm.	423	10	11	11	
Mean FL.	424	8	7	7	
	Total L	37	24	19	
	Expected under random misclassification		34.4	8.6	15.72
				TOTAL $X^2(1)$	16.17

APPENDIX 6.

Summary of the phenotypic scores of the yellowfin samples. The samples are listed with the Ecuador samples first, and the remainder are in reverse chronological order.

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
AKS	AA	98	1-1	192	1-1	0
200	AB	83	1-2	6	1-2	0
	BB	17	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	198	199	0
NUMBER UNSCORABLE	2	1	0
ALLELE FREQUENCY	(A)0.705	(1) 0.980	(1) 0.000
	(B)0.295	(2) 0.020	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANC 2	AA	123	1-1	193	1-1	0
207	AB	73	1-2	9	1-2	0
	BB	11	1-3	0	1-3	0
			1-4	2	1-4	0
			2-2	2	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	207	206	0
NUMBER UNSCORABLE	0	1	0
ALLELE FREQUENCY	(A)0.771	(1) 0.964	(1) 0.000
	(B)0.229	(2) 0.032	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANC 5	AA	98	1-1	164	1-1	0
171	AB	64	1-2	5	1-2	0
	BB	9	1-3	1	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	171	170	0
NUMBER UNSCORABLE	0	1	0
ALLELE FREQUENCY	(A)0.760	(1) 0.982	(1) 0.000
	(B)0.240	(2) 0.015	(2) 0.000
		(3) 0.003	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM	AA	132	1-1	175	1-1	0
198	AB	60	1-2	22	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	198		197		0
NUMBER UNSCORABLE	0		1		0
ALLELE FREQUENCY	(A)0.818	(1)	0.944	(1)	0.000
	(B)0.182	(2)	0.056	(2)	0.000
		(3)	0.000	(3)	0.000
		(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM B	AA	46	1-1	89	1-1	0
100	AB	48	1-2	9	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	1	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	100		100		0
NUMBER UNSCORABLE	0		0		0
ALLELE FREQUENCY	(A)0.700	(1)	0.940	(1)	0.000
	(B)0.300	(2)	0.050	(2)	0.000
		(3)	0.000	(3)	0.000
		(4)	0.010	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM F	AA	11	1-1	27	1-1	0
27	AB	14	1-2	0	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	27		27		0
NUMBER UNSCORABLE	0		0		0
ALLELE FREQUENCY	(A)0.667	(1)	1.000	(1)	0.000
	(B)0.333	(2)	0.000	(2)	0.000
		(3)	0.000	(3)	0.000
		(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM G	AA	43	1-1	84	1-1	0
91	AB	44	1-2	6	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	90	91	0
NUMBER UNSCORABLE	1	0	0
ALLELE FREQUENCY	(A)0.722	(1) 0.956	(1) 0.000
	(B)0.278	(2) 0.044	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM H	AA	49	1-1	84	1-1	0
89	AB	34	1-2	4	1-2	2
	BB	5	1-3	0	1-3	2
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	7
			2-4	0	2-4	0
			3-3	0	3-3	7
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	88	88	18
NUMBER UNSCORABLE	1	1	9
ALLELE FREQUENCY	(A)0.750	(1) 0.977	(1) 0.111
	(B)0.250	(2) 0.023	(2) 0.250
		(3) 0.000	(3) 0.639
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM I	AA	144	1-1	230	1-1	0
247	AB	92	1-2	12	1-2	0
	BB	11	1-3	2	1-3	0
			1-4	2	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	247	247	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.769	(1) 0.964	(1) 0.000
	(B)0.231	(2) 0.028	(2) 0.000
		(3) 0.004	(3) 0.000
		(4) 0.004	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM J	AA	54	1-1	81	1-1	0
87	AB	28	1-2	5	1-2	0
	BB	4	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	86	86	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.791	(1) 0.971	(1) 0.000
	(B)0.209	(2) 0.029	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ANM K	AA	107	1-1	205	1-1	1
218	AB	90	1-2	10	1-2	10
	BB	21	1-3	2	1-3	24
			1-4	1	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	60
			2-4	0	2-4	0
			3-3	0	3-3	55
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	218	218	166
NUMBER UNSCORABLE	0	0	8
ALLELE FREQUENCY	(A)0.697	(1) 0.970	(1) 0.108
	(B)0.303	(2) 0.023	(2) 0.307
		(3) 0.005	(3) 0.584
		(4) 0.002	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
APL	AA	122	1-1	189	1-1	0
200	AB	71	1-2	11	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	200	0
NUMBER UNSCORABLE	1	0	0
ALLELE FREQUENCY	(A)0.791	(1) 0.973	(1) 0.000
	(B)0.209	(2) 0.027	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL A	AA	6	1-1	23	1-1	0
24	AB	15	1-2	1	1-2	1
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	10
			2-3	0	2-3	12
			2-4	0	2-4	0
			3-3	0	3-3	1
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	24	24	24
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.562	(1) 0.979	(1) 0.021
	(B)0.437	(2) 0.021	(2) 0.687
		(3) 0.000	(3) 0.292
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL B	AA	18	1-1	46	1-1	0
47	AB	25	1-2	1	1-2	0
	BB	4	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	15
			2-3	0	2-3	21
			2-4	0	2-4	0
			3-3	0	3-3	10
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	47	47	47
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.649	(1) 0.989	(1) 0.011
	(B)0.351	(2) 0.011	(2) 0.543
		(3) 0.000	(3) 0.447
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL C	AA	2	1-1	7	1-1	0
8	AB	5	1-2	1	1-2	0
	BB	1	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	5
			2-3	0	2-3	2
			2-4	0	2-4	0
			3-3	0	3-3	1
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	8	8	8
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.562	(1) 0.937	(1) 0.000
	(B)0.437	(2) 0.062	(2) 0.750
		(3) 0.000	(3) 0.250
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL D	AA	1	1-1	11	1-1	0
11	AB	6	1-2	0	1-2	0
	BB	4	1-3	0	1-3	2
			1-4	0	1-4	0
			2-2	0	2-2	5
			2-3	0	2-3	4
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	11	11	11
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.364	(1) 1.000	(1) 0.091
	(B)0.636	(2) 0.000	(2) 0.636
		(3) 0.000	(3) 0.273
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL E	AA	9	1-1	27	1-1	0
27	AB	12	1-2	0	1-2	1
	BB	6	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	9
			2-3	0	2-3	13
			2-4	0	2-4	0
			3-3	0	3-3	3
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	27	27	27
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.556	(1) 1.000	(1) 0.037
	(B)0.444	(2) 0.000	(2) 0.593
		(3) 0.000	(3) 0.370
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL F	AA	21	1-1	68	1-1	0
72	AB	36	1-2	3	1-2	0
	BB	15	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	29
			2-3	0	2-3	30
			2-4	0	2-4	0
			3-3	0	3-3	13
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	72	72	72
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.542	(1) 0.972	(1) 0.000
	(B)0.458	(2) 0.021	(2) 0.611
		(3) 0.000	(3) 0.389
		(4) 0.007	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ATL G	AA	31	1-1	101	1-1	0
105	AB	57	1-2	4	1-2	1
	BB	17	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	38
			2-3	0	2-3	49
			2-4	0	2-4	1
			3-3	0	3-3	13
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	105	105	104
NUMBER UNSCORABLE	0	0	1
ALLELE FREQUENCY	(A)0.567	(1) 0.981	(1) 0.010
	(B)0.433	(2) 0.019	(2) 0.611
		(3) 0.000	(3) 0.370
		(4) 0.000	(4) 0.010

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
BC	AA	54	1-1	102	1-1	0
111	AB	41	1-2	7	1-2	0
	BB	16	1-3	0	1-3	0
			1-4	2	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	111	111	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.671	(1) 0.959	(1) 0.000
	(B)0.329	(2) 0.032	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.009	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC EC	AA	100	1-1	166	1-1	2
361	AB	71	1-2	13	1-2	12
	BB	10	1-3	0	1-3	24
			1-4	2	1-4	0
			2-2	0	2-2	15
			2-3	0	2-3	53
			2-4	0	2-4	0
			3-3	0	3-3	74
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	181	181	180
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.749	(1) 0.959	(1) 0.111
	(B)0.251	(2) 0.036	(2) 0.264
		(3) 0.000	(3) 0.625
		(4) 0.006	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC FC	AA	98	1-1	193	1-1	3
398	AB	88	1-2	7	1-2	11
	BB	15	1-3	0	1-3	34
			1-4	1	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	86
			2-4	0	2-4	0
			3-3	0	3-3	50
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	201	201	197
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.706	(1) 0.980	(1) 0.129
	(B)0.294	(2) 0.017	(2) 0.312
		(3) 0.000	(3) 0.558
		(4) 0.002	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC FF	AA	98	1-1	189	1-1	1
388	AB	81	1-2	9	1-2	7
	BB	20	1-3	0	1-3	28
			1-4	0	1-4	0
			2-2	1	2-2	13
			2-3	0	2-3	58
			2-4	0	2-4	0
			3-3	0	3-3	82
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	199	189
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.696	(1) 0.972	(1) 0.098
	(B)0.304	(2) 0.028	(2) 0.241
		(3) 0.000	(3) 0.661
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC GG	AA	125	1-1	240	1-1	5
443	AB	98	1-2	6	1-2	11
	BB	27	1-3	0	1-3	40
			1-4	3	1-4	0
			2-2	1	2-2	14
			2-3	0	2-3	62
			2-4	0	2-4	0
			3-3	0	3-3	60
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	250	250	193
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.696	(1) 0.978	(1) 0.158
	(B)0.304	(2) 0.016	(2) 0.262
		(3) 0.000	(3) 0.578
		(4) 0.006	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC HH	AA	99	1-1	189	1-1	2
398	AB	85	1-2	6	1-2	12
	BB	14	1-3	0	1-3	26
			1-4	3	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	53
			2-4	0	2-4	1
			3-3	0	3-3	81
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	198	198	199
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.715	(1) 0.977	(1) 0.106
	(B)0.285	(2) 0.015	(2) 0.286
		(3) 0.000	(3) 0.606
		(4) 0.008	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC II	AA	53	1-1	95	1-1	0
201	AB	40	1-2	1	1-2	7
	BB	7	1-3	2	1-3	9
			1-4	2	1-4	0
			2-2	0	2-2	8
			2-3	0	2-3	39
			2-4	0	2-4	0
			3-3	0	3-3	35
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	100	100	98
NUMBER UNSCORABLE	0	0	3
ALLELE FREQUENCY	(A)0.730	(1) 0.975	(1) 0.082
	(B)0.270	(2) 0.005	(2) 0.316
		(3) 0.010	(3) 0.602
		(4) 0.010	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CAC JJ	AA	79	1-1	134	1-1	3
279	AB	54	1-2	7	1-2	7
	BB	8	1-3	0	1-3	11
			1-4	0	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	49
			2-4	0	2-4	0
			3-3	0	3-3	55
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	141	141	138
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.752	(1) 0.975	(1) 0.087
	(B)0.248	(2) 0.025	(2) 0.297
		(3) 0.000	(3) 0.616
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ A1	AA	115	1-1	181	1-1	0
200	AB	70	1-2	13	1-2	0
	BB	11	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	2	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	196	196	0
NUMBER UNSCORABLE	4	4	0
ALLELE FREQUENCY	(A)0.765	(1) 0.957	(1) 0.000
	(B)0.235	(2) 0.043	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ A2	AA	111	1-1	178	1-1	0
200	AB	68	1-2	12	1-2	0
	BB	9	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	2	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	188	192	0
NUMBER UNSCORABLE	11	7	0
ALLELE FREQUENCY	(A)0.771	(1) 0.958	(1) 0.000
	(B)0.229	(2) 0.042	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ D1	AA	22	1-1	47	1-1	0
50	AB	25	1-2	2	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	49	49	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.704	(1) 0.980	(1) 0.000
	(B)0.296	(2) 0.020	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ D2	AA	20	1-1	38	1-1	0
50	AB	14	1-2	1	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	34	40	0
NUMBER UNSCORABLE	16	10	0
ALLELE FREQUENCY	(A)0.794	(1) 0.975	(1) 0.000
	(B)0.206	(2) 0.013	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.013	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ E1	AA	18	1-1	31	1-1	0
41	AB	20	1-2	10	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	41	41	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.683	(1) 0.878	(1) 0.000
	(B)0.317	(2) 0.122	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CNJ E2	AA	16	1-1	39	1-1	0
41	AB	19	1-2	2	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	41	41	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.622	(1) 0.976	(1) 0.000
	(B)0.378	(2) 0.024	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CRC A	AA	42	1-1	57	1-1	0
128	AB	18	1-2	6	1-2	3
	BB	4	1-3	0	1-3	9
			1-4	0	1-4	0
			2-2	0	2-2	11
			2-3	0	2-3	15
			2-4	0	2-4	0
			3-3	0	3-3	26
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	64	63	64
NUMBER UNSCORABLE	0	1	0
ALLELE FREQUENCY	(A)0.797	(1) 0.952	(1) 0.094
	(B)0.203	(2) 0.048	(2) 0.312
		(3) 0.000	(3) 0.594
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CRC A1	AA	80	1-1	143	1-1	1
251	AB	64	1-2	9	1-2	6
	BB	10	1-3	0	1-3	14
			1-4	1	1-4	0
			2-2	1	2-2	13
			2-3	0	2-3	36
			2-4	0	2-4	0
			3-3	0	3-3	25
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	154	154	95
NUMBER UNSCORABLE	1	1	1
ALLELE FREQUENCY	(A)0.727	(1) 0.961	(1) 0.116
	(B)0.273	(2) 0.036	(2) 0.358
		(3) 0.000	(3) 0.526
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CRC AD	AA	86	1-1	135	1-1	1
257	AB	58	1-2	16	1-2	12
	BB	9	1-3	1	1-3	17
			1-4	1	1-4	0
			2-2	0	2-2	9
			2-3	0	2-3	51
			2-4	0	2-4	0
			3-3	0	3-3	63
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	153	153	153
NUMBER UNSCORABLE	1	1	1
ALLELE FREQUENCY	(A)0.752	(1) 0.941	(1) 0.101
	(B)0.248	(2) 0.052	(2) 0.265
		(3) 0.003	(3) 0.634
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CRC D	AA	8	1-1	10	1-1	0
11	AB	3	1-2	1	1-2	0
	BB	0	1-3	0	1-3	3
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	3
			2-4	0	2-4	0
			3-3	0	3-3	5
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	11	11	11
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.864	(1) 0.955	(1) 0.136
	(B)0.136	(2) 0.045	(2) 0.136
		(3) 0.000	(3) 0.727
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CUA	AA	84	1-1	0	1-1	0
193	AB	81	1-2	0	1-2	0
	BB	18	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	183	0	0
NUMBER UNSCORABLE	10	193	0
ALLELE FREQUENCY	(A)0.680	(1) 0.000	(1) 0.000
	(B)0.320	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
CYV	AA	21	1-1	21	1-1	0
50	AB	17	1-2	0	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	44	21	0
NUMBER UNSCORABLE	6	29	0
ALLELE FREQUENCY	(A)0.670	(1) 1.000	(1) 0.000
	(B)0.330	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU A	AA	0	1-1	0	1-1	0
31	AB	2	1-2	0	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	2	0	0
NUMBER UNSCORABLE	29	31	0
ALLELE FREQUENCY	(A)0.500	(1) 0.000	(1) 0.000
	(B)0.500	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU B	AA	91	1-1	190	1-1	2
347	AB	82	1-2	3	1-2	12
	BB	15	1-3	3	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	15
			2-3	0	2-3	73
			2-4	0	2-4	0
			3-3	0	3-3	68
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	188	196	194
NUMBER UNSCORABLE	11	3	4
ALLELE FREQUENCY	(A)0.702	(1) 0.985	(1) 0.103
	(B)0.298	(2) 0.008	(2) 0.296
		(3) 0.008	(3) 0.601
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU C	AA	68	1-1	160	1-1	2
292	AB	72	1-2	5	1-2	11
	BB	18	1-3	1	1-3	15
			1-4	2	1-4	0
			2-2	0	2-2	17
			2-3	0	2-3	59
			2-4	0	2-4	0
			3-3	0	3-3	57
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	158	168	161
NUMBER UNSCORABLE	13	3	10
ALLELE FREQUENCY	(A)0.658	(1) 0.976	(1) 0.093
	(B)0.342	(2) 0.015	(2) 0.323
		(3) 0.003	(3) 0.584
		(4) 0.006	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU D	AA	91	1-1	159	1-1	1
270	AB	49	1-2	0	1-2	7
	BB	14	1-3	0	1-3	19
			1-4	1	1-4	0
			2-2	0	2-2	11
			2-3	0	2-3	57
			2-4	0	2-4	0
			3-3	0	3-3	58
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	154	160	153
NUMBER UNSCORABLE	6	0	7
ALLELE FREQUENCY	(A)0.750	(1) 0.997	(1) 0.092
	(B)0.250	(2) 0.000	(2) 0.281
		(3) 0.000	(3) 0.627
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU E	AA	116	1-1	197	1-1	3
348	AB	74	1-2	1	1-2	10
	BB	8	1-3	0	1-3	29
			1-4	1	1-4	0
			2-2	0	2-2	21
			2-3	0	2-3	55
			2-4	0	2-4	0
			3-3	0	3-3	79
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	198	199	197
NUMBER UNSCORABLE	2	1	1
ALLELE FREQUENCY	(A)0.773	(1) 0.995	(1) 0.114
	(B)0.227	(2) 0.003	(2) 0.272
		(3) 0.000	(3) 0.614
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU F	AA	109	1-1	183	1-1	0
326	AB	61	1-2	4	1-2	11
	BB	16	1-3	0	1-3	27
			1-4	0	1-4	0
			2-2	0	2-2	23
			2-3	0	2-3	56
			2-4	0	2-4	0
			3-3	0	3-3	65
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	186	187	182
NUMBER UNSCORABLE	2	1	6
ALLELE FREQUENCY	(A)0.750	(1) 0.989	(1) 0.104
	(B)0.250	(2) 0.011	(2) 0.310
		(3) 0.000	(3) 0.585
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU G	AA	103	1-1	185	1-1	2
351	AB	75	1-2	8	1-2	9
	BB	16	1-3	0	1-3	29
			1-4	0	1-4	0
			2-2	0	2-2	23
			2-3	0	2-3	60
			2-4	0	2-4	0
			3-3	0	3-3	72
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	194	193	195
NUMBER UNSCORABLE	6	7	6
ALLELE FREQUENCY	(A)0.724	(1) 0.979	(1) 0.108
	(B)0.276	(2) 0.021	(2) 0.295
		(3) 0.000	(3) 0.597
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU H	AA	108	1-1	0	1-1	2
348	AB	81	1-2	0	1-2	16
	BB	9	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	20
			2-3	0	2-3	65
			2-4	0	2-4	0
			3-3	0	3-3	64
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	198	0	191
NUMBER UNSCORABLE	1	199	8
ALLELE FREQUENCY	(A)0.750	(1) 0.000	(1) 0.115
	(B)0.250	(2) 0.000	(2) 0.317
		(3) 0.000	(3) 0.568
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU I	AA	111	1-1	0	1-1	3
350	AB	76	1-2	0	1-2	9
	BB	13	1-3	0	1-3	32
			1-4	0	1-4	0
			2-2	0	2-2	22
			2-3	0	2-3	79
			2-4	0	2-4	0
			3-3	0	3-3	44
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	200	0	189
NUMBER UNSCORABLE	0	200	11
ALLELE FREQUENCY	(A)0.745	(1) 0.000	(1) 0.124
	(B)0.255	(2) 0.000	(2) 0.349
		(3) 0.000	(3) 0.526
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU J	AA	65	1-1	0	1-1	0
211	AB	56	1-2	0	1-2	5
	BB	10	1-3	0	1-3	18
			1-4	0	1-4	0
			2-2	0	2-2	19
			2-3	0	2-3	48
			2-4	0	2-4	0
			3-3	0	3-3	39
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	131	0	129
NUMBER UNSCORABLE	0	131	1
ALLELE FREQUENCY	(A)0.710	(1) 0.000	(1) 0.089
	(B)0.290	(2) 0.000	(2) 0.353
		(3) 0.000	(3) 0.558
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU JC	AA	252	1-1	33	1-1	0
465	AB	175	1-2	4	1-2	0
	BB	37	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	464	37	0
NUMBER UNSCORABLE	1	428	0
ALLELE FREQUENCY	(A)0.732	(1) 0.946	(1) 0.000
	(B)0.268	(2) 0.054	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU K	AA	108	1-1	0	1-1	2
350	AB	80	1-2	0	1-2	13
	BB	12	1-3	0	1-3	22
			1-4	0	1-4	0
			2-2	0	2-2	18
			2-3	0	2-3	81
			2-4	0	2-4	1
			3-3	0	3-3	62
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	200	0	199
NUMBER UNSCORABLE	0	200	1
ALLELE FREQUENCY	(A)0.740	(1) 0.000	(1) 0.098
	(B)0.260	(2) 0.000	(2) 0.329
		(3) 0.000	(3) 0.570
		(4) 0.000	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU L	AA	117	1-1	0	1-1	3
350	AB	75	1-2	0	1-2	15
	BB	8	1-3	0	1-3	15
			1-4	0	1-4	0
			2-2	0	2-2	19
			2-3	0	2-3	85
			2-4	0	2-4	0
			3-3	0	3-3	61
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	0	198
NUMBER UNSCORABLE	0	200	2
ALLELE FREQUENCY	(A)0.772	(1) 0.000	(1) 0.091
	(B)0.228	(2) 0.000	(2) 0.348
		(3) 0.000	(3) 0.561
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU M	AA	92	1-1	0	1-1	0
349	AB	85	1-2	0	1-2	11
	BB	23	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	77
			2-4	0	2-4	0
			3-3	0	3-3	61
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	0	197
NUMBER UNSCORABLE	0	200	2
ALLELE FREQUENCY	(A)0.673	(1) 0.000	(1) 0.089
	(B)0.327	(2) 0.000	(2) 0.345
		(3) 0.000	(3) 0.566
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU N	AA	113	1-1	180	1-1	1
350	AB	73	1-2	12	1-2	14
	BB	13	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	18
			2-3	0	2-3	62
			2-4	0	2-4	0
			3-3	0	3-3	77
			3-4	0	3-4	2
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	192	198
NUMBER UNSCORABLE	1	8	2
ALLELE FREQUENCY	(A)0.751	(1) 0.969	(1) 0.101
	(B)0.249	(2) 0.031	(2) 0.283
		(3) 0.000	(3) 0.611
		(4) 0.000	(4) 0.005

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU O	AA	31	1-1	1	1-1	0
152	AB	41	1-2	0	1-2	6
	BB	4	1-3	0	1-3	6
			1-4	0	1-4	0
			2-2	0	2-2	10
			2-3	0	2-3	34
			2-4	0	2-4	0
			3-3	0	3-3	20
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	76	1	76
NUMBER UNSCORABLE	0	75	0
ALLELE FREQUENCY	(A)0.678	(1) 1.000	(1) 0.079
	(B)0.322	(2) 0.000	(2) 0.395
		(3) 0.000	(3) 0.526
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU P	AA	124	1-1	185	1-1	1
350	AB	64	1-2	15	1-2	15
	BB	12	1-3	0	1-3	23
			1-4	0	1-4	0
			2-2	0	2-2	27
			2-3	0	2-3	70
			2-4	0	2-4	0
			3-3	0	3-3	60
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	196
NUMBER UNSCORABLE	0	0	4
ALLELE FREQUENCY	(A)0.780	(1) 0.962	(1) 0.102
	(B)0.220	(2) 0.038	(2) 0.355
		(3) 0.000	(3) 0.543
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU Q	AA	96	1-1	0	1-1	4
350	AB	85	1-2	0	1-2	14
	BB	19	1-3	0	1-3	18
			1-4	0	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	70
			2-4	0	2-4	0
			3-3	0	3-3	75
			3-4	0	3-4	3
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	0	200
NUMBER UNSCORABLE	0	200	0
ALLELE FREQUENCY	(A)0.692	(1) 0.000	(1) 0.100
	(B)0.308	(2) 0.000	(2) 0.290
		(3) 0.000	(3) 0.603
		(4) 0.000	(4) 0.007

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU R	AA	121	1-1	190	1-1	0
348	AB	67	1-2	8	1-2	6
	BB	11	1-3	0	1-3	22
			1-4	0	1-4	0
			2-2	0	2-2	25
			2-3	0	2-3	70
			2-4	0	2-4	0
			3-3	0	3-3	75
			3-4	0	3-4	0
			4-4	1	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	199	198
NUMBER UNSCORABLE	0	0	1
ALLELE FREQUENCY	(A)0.776	(1) 0.975	(1) 0.071
	(B)0.224	(2) 0.020	(2) 0.318
		(3) 0.000	(3) 0.611
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU S	AA	97	1-1	193	1-1	3
350	AB	85	1-2	7	1-2	7
	BB	18	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	26
			2-3	0	2-3	74
			2-4	0	2-4	0
			3-3	0	3-3	66
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.697	(1) 0.983	(1) 0.093
	(B)0.303	(2) 0.018	(2) 0.333
		(3) 0.000	(3) 0.575
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU T	AA	107	1-1	191	1-1	3
350	AB	82	1-2	6	1-2	11
	BB	10	1-3	1	1-3	22
			1-4	0	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	78
			2-4	0	2-4	0
			3-3	0	3-3	61
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	198	199
NUMBER UNSCORABLE	1	2	1
ALLELE FREQUENCY	(A)0.744	(1) 0.982	(1) 0.098
	(B)0.256	(2) 0.015	(2) 0.344
		(3) 0.003	(3) 0.558
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU U	AA	112	1-1	0	1-1	3
350	AB	74	1-2	0	1-2	11
	BB	14	1-3	0	1-3	29
			1-4	0	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	80
			2-4	0	2-4	0
			3-3	0	3-3	53
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	200	0	200
NUMBER UNSCORABLE	0	200	0
ALLELE FREQUENCY	(A)0.745	(1) 0.000	(1) 0.115
	(B)0.255	(2) 0.000	(2) 0.347
		(3) 0.000	(3) 0.538
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU V	AA	98	1-1	195	1-1	0
200	AB	87	1-2	5	1-2	14
	BB	15	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	28
			2-3	0	2-3	81
			2-4	0	2-4	0
			3-3	0	3-3	51
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	200	200	198
NUMBER UNSCORABLE	0	0	2
ALLELE FREQUENCY	(A)0.707	(1) 0.988	(1) 0.096
	(B)0.293	(2) 0.013	(2) 0.381
		(3) 0.000	(3) 0.523
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU W	AA	85	1-1	152	1-1	1
163	AB	71	1-2	8	1-2	11
	BB	7	1-3	0	1-3	27
			1-4	3	1-4	0
			2-2	0	2-2	21
			2-3	0	2-3	56
			2-4	0	2-4	0
			3-3	0	3-3	47
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	163	163	163
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.739	(1) 0.966	(1) 0.123
	(B)0.261	(2) 0.025	(2) 0.334
		(3) 0.000	(3) 0.543
		(4) 0.009	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU X	AA	102	1-1	188	1-1	3
200	AB	85	1-2	9	1-2	9
	BB	13	1-3	0	1-3	29
			1-4	3	1-4	0
			2-2	0	2-2	23
			2-3	0	2-3	83
			2-4	0	2-4	0
			3-3	0	3-3	53
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.723	(1) 0.970	(1) 0.110
	(B)0.277	(2) 0.023	(2) 0.345
		(3) 0.000	(3) 0.545
		(4) 0.007	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU XA	AA	13	1-1	17	1-1	0
24	AB	11	1-2	6	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	1	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	24	24	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.771	(1) 0.833	(1) 0.000
	(B)0.229	(2) 0.146	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.021	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU XB	AA	15	1-1	27	1-1	0
28	AB	12	1-2	0	1-2	0
	BB	1	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	28	28	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.750	(1) 0.982	(1) 0.000
	(B)0.250	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.018	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU XX	AA	102	1-1	185	1-1	0
198	AB	77	1-2	10	1-2	0
	BB	16	1-3	1	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	195		196		0
NUMBER UNSCORABLE	3		2		0
ALLELE FREQUENCY	(A)0.721	(1)	0.972	(1)	0.000
	(B)0.279	(2)	0.026	(2)	0.000
		(3)	0.003	(3)	0.000
		(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU Y	AA	108	1-1	188	1-1	4
200	AB	74	1-2	12	1-2	10
	BB	18	1-3	0	1-3	19
			1-4	0	1-4	0
			2-2	0	2-2	18
			2-3	0	2-3	68
			2-4	0	2-4	0
			3-3	0	3-3	80
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	200		200		199
NUMBER UNSCORABLE	0		0		1
ALLELE FREQUENCY	(A)0.725	(1)	0.970	(1)	0.093
	(B)0.275	(2)	0.030	(2)	0.286
		(3)	0.000	(3)	0.621
		(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ECU Z	AA	81	1-1	136	1-1	1
145	AB	46	1-2	6	1-2	16
	BB	17	1-3	0	1-3	12
			1-4	2	1-4	0
			2-2	0	2-2	17
			2-3	0	2-3	51
			2-4	0	2-4	0
			3-3	0	3-3	47
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	144		144		144
NUMBER UNSCORABLE	1		1		1
ALLELE FREQUENCY	(A)0.722	(1)	0.972	(1)	0.104
	(B)0.278	(2)	0.021	(2)	0.351
		(3)	0.000	(3)	0.545
		(4)	0.007	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ELS	AA	109	1-1	186	1-1	0
192	AB	71	1-2	5	1-2	0
	BB	11	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	191	191	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.757	(1) 0.987	(1) 0.000
	(B)0.243	(2) 0.013	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ETP	AA	0	1-1	0	1-1	0
50	AB	0	1-2	0	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	0	0	0
NUMBER UNSCORABLE	50	50	0
ALLELE FREQUENCY	(A)0.000	(1) 0.000	(1) 0.000
	(B)0.000	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM K1	AA	117	1-1	189	1-1	0
200	AB	69	1-2	9	1-2	0
	BB	14	1-3	2	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	200	200	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.757	(1) 0.973	(1) 0.000
	(B)0.243	(2) 0.023	(2) 0.000
		(3) 0.005	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM K2	AA	104	1-1	187	1-1	0
200	AB	83	1-2	11	1-2	10
	BB	13	1-3	2	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	22
			2-3	0	2-3	75
			2-4	0	2-4	0
			3-3	0	3-3	65
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	197
NUMBER UNSCORABLE	0	0	3
ALLELE FREQUENCY	(A)0.728	(1) 0.967	(1) 0.086
	(B)0.272	(2) 0.027	(2) 0.327
		(3) 0.005	(3) 0.584
		(4) 0.000	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM L	AA	105	1-1	188	1-1	2
198	AB	72	1-2	8	1-2	7
	BB	19	1-3	0	1-3	33
			1-4	0	1-4	0
			2-2	0	2-2	21
			2-3	0	2-3	62
			2-4	0	2-4	0
			3-3	0	3-3	69
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	196	196	194
NUMBER UNSCORABLE	2	2	4
ALLELE FREQUENCY	(A)0.719	(1) 0.980	(1) 0.113
	(B)0.281	(2) 0.020	(2) 0.286
		(3) 0.000	(3) 0.601
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM M	AA	120	1-1	198	1-1	2
434	AB	83	1-2	17	1-2	14
	BB	14	1-3	0	1-3	21
			1-4	2	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	82
			2-4	0	2-4	0
			3-3	0	3-3	77
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	217	217	212
NUMBER UNSCORABLE	1	1	4
ALLELE FREQUENCY	(A)0.744	(1) 0.956	(1) 0.092
	(B)0.256	(2) 0.039	(2) 0.302
		(3) 0.000	(3) 0.606
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM N	AA	109	1-1	0	1-1	1
324	AB	84	1-2	0	1-2	2
	BB	12	1-3	0	1-3	14
			1-4	0	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	38
			2-4	0	2-4	0
			3-3	0	3-3	44
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	205	0	111
NUMBER UNSCORABLE	5	210	3
ALLELE FREQUENCY	(A)0.737	(1) 0.000	(1) 0.081
	(B)0.263	(2) 0.000	(2) 0.288
		(3) 0.000	(3) 0.631
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
GEM Z	AA	29	1-1	54	1-1	0
56	AB	20	1-2	1	1-2	0
	BB	7	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	56	56	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.696	(1) 0.982	(1) 0.000
	(B)0.304	(2) 0.009	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.009	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
HST	AA	99	1-1	0	1-1	0
200	AB	84	1-2	0	1-2	0
	BB	17	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	0	0
NUMBER UNSCORABLE	0	200	0
ALLELE FREQUENCY	(A)0.705	(1) 0.000	(1) 0.000
	(B)0.295	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
IDP	AA	98	1-1	181	1-1	0
196	AB	83	1-2	12	1-2	0
	BB	13	1-3	0	1-3	0
			1-4	2	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	194	195	0
NUMBER UNSCORABLE	2	1	0
ALLELE FREQUENCY	(A)0.719	(1) 0.964	(1) 0.000
	(B)0.281	(2) 0.031	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
INV	AA	103	1-1	149	1-1	0
159	AB	43	1-2	6	1-2	15
	BB	10	1-3	1	1-3	16
			1-4	0	1-4	0
			2-2	0	2-2	14
			2-3	0	2-3	60
			2-4	0	2-4	0
			3-3	0	3-3	50
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	156	156	155
NUMBER UNSCORABLE	3	3	4
ALLELE FREQUENCY	(A)0.798	(1) 0.978	(1) 0.100
	(B)0.202	(2) 0.019	(2) 0.332
		(3) 0.003	(3) 0.568
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JHN F	AA	120	1-1	208	1-1	0
228	AB	85	1-2	6	1-2	2
	BB	10	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	96
			2-3	0	2-3	88
			2-4	0	2-4	1
			3-3	0	3-3	28
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	215	215	215
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.756	(1) 0.984	(1) 0.005
	(B)0.244	(2) 0.014	(2) 0.658
		(3) 0.000	(3) 0.335
		(4) 0.002	(4) 0.002

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JMM AA	AA	49	1-1	91	1-1	0
100	AB	38	1-2	6	1-2	0
	BB	12	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	1	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	99	99	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.687	(1) 0.955	(1) 0.000
	(B)0.313	(2) 0.035	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.010	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JMM BB	AA	61	1-1	87	1-1	0
95	AB	24	1-2	7	1-2	0
	BB	10	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	95	95	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.768	(1) 0.958	(1) 0.000
	(B)0.232	(2) 0.037	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JMM CC	AA	42	1-1	82	1-1	0
89	AB	40	1-2	6	1-2	0
	BB	7	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	89	89	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.697	(1) 0.961	(1) 0.000
	(B)0.303	(2) 0.034	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.006	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JMM DD	AA	55	1-1	0	1-1	1
202	AB	40	1-2	0	1-2	5
	BB	5	1-3	0	1-3	15
			1-4	0	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	29
			2-4	0	2-4	0
			3-3	0	3-3	35
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	100	0	101
NUMBER UNSCORABLE	0	100	1
ALLELE FREQUENCY	(A)0.750	(1) 0.000	(1) 0.109
	(B)0.250	(2) 0.000	(2) 0.327
		(3) 0.000	(3) 0.564
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JMM EE	AA	86	1-1	0	1-1	0
284	AB	44	1-2	0	1-2	7
	BB	8	1-3	0	1-3	18
			1-4	0	1-4	0
			2-2	0	2-2	15
			2-3	0	2-3	53
			2-4	0	2-4	0
			3-3	0	3-3	53
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	138	0	146
NUMBER UNSCORABLE	0	138	0
ALLELE FREQUENCY	(A)0.783	(1) 0.000	(1) 0.086
	(B)0.217	(2) 0.000	(2) 0.308
		(3) 0.000	(3) 0.606
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JNC	AA	0	1-1	0	1-1	0
50	AB	0	1-2	0	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	0	0	0
NUMBER UNSCORABLE	50	50	0
ALLELE FREQUENCY	(A)0.000	(1) 0.000	(1) 0.000
	(B)0.000	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
KRM KD	AA	51	1-1	94	1-1	0
148	AB	37	1-2	3	1-2	12
	BB	10	1-3	0	1-3	16
			1-4	0	1-4	0
			2-2	0	2-2	5
			2-3	0	2-3	20
			2-4	1	2-4	0
			3-3	0	3-3	46
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	98	98	99
NUMBER UNSCORABLE	2	2	1
ALLELE FREQUENCY	(A)0.709	(1) 0.974	(1) 0.141
	(B)0.291	(2) 0.020	(2) 0.212
		(3) 0.000	(3) 0.646
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
KRM KS	AA	83	1-1	140	1-1	0
288	AB	48	1-2	4	1-2	4
	BB	14	1-3	0	1-3	30
			1-4	1	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	41
			2-4	0	2-4	0
			3-3	0	3-3	56
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	145	145	143
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.738	(1) 0.983	(1) 0.119
	(B)0.262	(2) 0.014	(2) 0.241
		(3) 0.000	(3) 0.640
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MB	AA	65	1-1	128	1-1	0
133	AB	59	1-2	4	1-2	0
	BB	8	1-3	1	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	132	133	0
NUMBER UNSCORABLE	1	0	0
ALLELE FREQUENCY	(A)0.716	(1) 0.981	(1) 0.000
	(B)0.284	(2) 0.015	(2) 0.000
		(3) 0.004	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME B	AA	101	1-1	193	1-1	0
200	AB	86	1-2	6	1-2	5
	BB	13	1-3	0	1-3	1
			1-4	1	1-4	0
			2-2	0	2-2	81
			2-3	0	2-3	91
			2-4	0	2-4	0
			3-3	0	3-3	22
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.720	(1) 0.983	(1) 0.015
	(B)0.280	(2) 0.015	(2) 0.645
		(3) 0.000	(3) 0.340
		(4) 0.002	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME E	AA	104	1-1	190	1-1	0
199	AB	82	1-2	5	1-2	5
	BB	12	1-3	1	1-3	2
			1-4	2	1-4	0
			2-2	0	2-2	93
			2-3	0	2-3	81
			2-4	0	2-4	0
			3-3	0	3-3	17
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	198	198	198
NUMBER UNSCORABLE	1	1	1
ALLELE FREQUENCY	(A)0.732	(1) 0.980	(1) 0.018
	(B)0.268	(2) 0.013	(2) 0.687
		(3) 0.003	(3) 0.295
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME F	AA	62	1-1	102	1-1	0
112	AB	40	1-2	8	1-2	2
	BB	10	1-3	0	1-3	2
			1-4	1	1-4	0
			2-2	1	2-2	52
			2-3	0	2-3	44
			2-4	0	2-4	0
			3-3	0	3-3	12
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	112	112	112
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.732	(1) 0.951	(1) 0.018
	(B)0.268	(2) 0.045	(2) 0.670
		(3) 0.000	(3) 0.312
		(4) 0.004	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK B	AA	108	1-1	189	1-1	1
198	AB	82	1-2	8	1-2	12
	BB	8	1-3	0	1-3	24
			1-4	0	1-4	0
			2-2	0	2-2	27
			2-3	0	2-3	61
			2-4	0	2-4	1
			3-3	0	3-3	70
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	198	197	196
NUMBER UNSCORABLE	0	1	2
ALLELE FREQUENCY	(A)0.753	(1) 0.980	(1) 0.097
	(B)0.247	(2) 0.020	(2) 0.327
		(3) 0.000	(3) 0.574
		(4) 0.000	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK B2	AA	113	1-1	186	1-1	4
200	AB	74	1-2	12	1-2	13
	BB	11	1-3	0	1-3	22
			1-4	0	1-4	0
			2-2	0	2-2	15
			2-3	0	2-3	73
			2-4	0	2-4	0
			3-3	0	3-3	71
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	198	198	198
NUMBER UNSCORABLE	2	2	2
ALLELE FREQUENCY	(A)0.758	(1) 0.970	(1) 0.109
	(B)0.242	(2) 0.030	(2) 0.293
		(3) 0.000	(3) 0.598
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK C	AA	0	1-1	0	1-1	0
24	AB	0	1-2	0	1-2	2
	BB	0	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	1
			2-3	0	2-3	11
			2-4	0	2-4	0
			3-3	0	3-3	9
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	0	0	24
NUMBER UNSCORABLE	24	24	0
ALLELE FREQUENCY	(A)0.000	(1) 0.000	(1) 0.062
	(B)0.000	(2) 0.000	(2) 0.312
		(3) 0.000	(3) 0.625
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK E	AA	119	1-1	185	1-1	2
200	AB	67	1-2	12	1-2	10
	BB	13	1-3	0	1-3	32
			1-4	0	1-4	0
			2-2	0	2-2	18
			2-3	0	2-3	61
			2-4	1	2-4	0
			3-3	0	3-3	76
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	198	199
NUMBER UNSCORABLE	1	2	1
ALLELE FREQUENCY	(A)0.766	(1) 0.965	(1) 0.116
	(B)0.234	(2) 0.033	(2) 0.269
		(3) 0.000	(3) 0.616
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK F	AA	67	1-1	116	1-1	0
121	AB	43	1-2	1	1-2	6
	BB	7	1-3	0	1-3	15
			1-4	0	1-4	0
			2-2	0	2-2	6
			2-3	0	2-3	43
			2-4	0	2-4	0
			3-3	0	3-3	50
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	117	117	120
NUMBER UNSCORABLE	4	4	1
ALLELE FREQUENCY	(A)0.756	(1) 0.996	(1) 0.087
	(B)0.244	(2) 0.004	(2) 0.254
		(3) 0.000	(3) 0.658
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP A	AA	86	1-1	161	1-1	1
286	AB	76	1-2	6	1-2	3
	BB	6	1-3	0	1-3	13
			1-4	1	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	71
			2-4	0	2-4	0
			3-3	0	3-3	68
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	168	168	168
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.738	(1) 0.979	(1) 0.054
	(B)0.262	(2) 0.018	(2) 0.292
		(3) 0.000	(3) 0.655
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP A1	AA	115	1-1	186	1-1	0
205	AB	74	1-2	14	1-2	0
	BB	16	1-3	0	1-3	0
			1-4	4	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	1	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	205	205	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.741	(1) 0.951	(1) 0.000
	(B)0.259	(2) 0.037	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.012	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP B	AA	34	1-1	49	1-1	0
54	AB	18	1-2	5	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	54	54	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.796	(1) 0.954	(1) 0.000
	(B)0.204	(2) 0.046	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP BC	AA	162	1-1	297	1-1	0
311	AB	128	1-2	11	1-2	0
	BB	19	1-3	1	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	309	310	0
NUMBER UNSCORABLE	2	1	0
ALLELE FREQUENCY	(A)0.731	(1) 0.979	(1) 0.000
	(B)0.269	(2) 0.018	(2) 0.000
		(3) 0.002	(3) 0.000
		(4) 0.002	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP C	AA	94	1-1	177	1-1	0
188	AB	78	1-2	10	1-2	0
	BB	14	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	186	188	0
NUMBER UNSCORABLE	2	0	0
ALLELE FREQUENCY	(A)0.715	(1) 0.968	(1) 0.000
	(B)0.285	(2) 0.032	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP D1	AA	4	1-1	6	1-1	0
8	AB	4	1-2	1	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	8	8	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.750	(1) 0.875	(1) 0.000
	(B)0.250	(2) 0.062	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.062	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP E1	AA	18	1-1	30	1-1	0
34	AB	13	1-2	2	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	2	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	34	34	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.721	(1) 0.941	(1) 0.000
	(B)0.279	(2) 0.029	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.029	(4) 0.000

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SAMPLE    TFN-SCORE EST-SCORE PGI-SCORE
MP  G     AA    68   1-1 140   1-1    2
   242    AB    63   1-2   6   1-2    4
          BB    12   1-3   0   1-3   25
                     1-4   0   1-4    0
                     2-2   0   2-2    8
                     2-3   0   2-3   59
                     2-4   0   2-4    0
                     3-3   0   3-3   47
                     3-4   0   3-4    1
                     4-4   0   4-4    0

TOTAL FISH SCORED      TFN        EST        PGI
                       143        146        146
NUMBER UNSCORABLE        3          0          0
ALLELE FREQUENCY (A)0.696 (1) 0.979 (1) 0.113
                 (B)0.304 (2) 0.021 (2) 0.271
                          (3) 0.000 (3) 0.613
                          (4) 0.000 (4) 0.003

SAMPLE    TFN-SCORE EST-SCORE PGI-SCORE
MP  I     AA    91   1-1 164   1-1    2
   295    AB    68   1-2   6   1-2    9
          BB    14   1-3   1   1-3   24
                     1-4   1   1-4    0
                     2-2   0   2-2   14
                     2-3   0   2-3   63
                     2-4   0   2-4    0
                     3-3   0   3-3   60
                     3-4   0   3-4    0
                     4-4   0   4-4    0

TOTAL FISH SCORED      TFN        EST        PGI
                       173        172        172
NUMBER UNSCORABLE        0          1          0
ALLELE FREQUENCY (A)0.723 (1) 0.977 (1) 0.108
                 (B)0.277 (2) 0.017 (2) 0.291
                          (3) 0.003 (3) 0.602
                          (4) 0.003 (4) 0.000

SAMPLE    TFN-SCORE EST-SCORE PGI-SCORE
MP  O     AA   103   1-1 186   1-1    2
   346    AB    81   1-2  10   1-2    7
          BB    14   1-3   1   1-3   26
                     1-4   1   1-4    0
                     2-2   0   2-2   11
                     2-3   0   2-3   68
                     2-4   0   2-4    0
                     3-3   0   3-3   82
                     3-4   0   3-4    0
                     4-4   0   4-4    0

TOTAL FISH SCORED      TFN        EST        PGI
                       198        198        196
NUMBER UNSCORABLE        0          0          2
ALLELE FREQUENCY (A)0.725 (1) 0.970 (1) 0.094
                 (B)0.275 (2) 0.025 (2) 0.247
                          (3) 0.003 (3) 0.658
                          (4) 0.003 (4) 0.000
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SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MP P	AA	92	1-1	175	1-1	1
184	AB	74	1-2	8	1-2	12
	BB	18	1-3	0	1-3	22
			1-4	0	1-4	0
			2-2	1	2-2	14
			2-3	0	2-3	69
			2-4	0	2-4	0
			3-3	0	3-3	66
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	184	184	184
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.701	(1) 0.973	(1) 0.098
	(B)0.299	(2) 0.027	(2) 0.296
		(3) 0.000	(3) 0.606
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRA H	AA	111	1-1	195	1-1	1
400	AB	76	1-2	5	1-2	16
	BB	13	1-3	0	1-3	23
			1-4	0	1-4	0
			2-2	0	2-2	26
			2-3	0	2-3	81
			2-4	0	2-4	0
			3-3	0	3-3	53
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.745	(1) 0.988	(1) 0.102
	(B)0.255	(2) 0.013	(2) 0.373
		(3) 0.000	(3) 0.525
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRA I	AA	109	1-1	190	1-1	2
405	AB	79	1-2	8	1-2	9
	BB	13	1-3	0	1-3	29
			1-4	3	1-4	1
			2-2	0	2-2	11
			2-3	0	2-3	79
			2-4	0	2-4	0
			3-3	0	3-3	72
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	201	201	204
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.739	(1) 0.973	(1) 0.105
	(B)0.261	(2) 0.020	(2) 0.270
		(3) 0.000	(3) 0.620
		(4) 0.007	(4) 0.005

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRA X	AA	89	1-1	167	1-1	1
351	AB	69	1-2	7	1-2	9
	BB	18	1-3	0	1-3	14
			1-4	1	1-4	0
			2-2	1	2-2	21
			2-3	0	2-3	75
			2-4	0	2-4	0
			3-3	0	3-3	53
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	176	176	173
NUMBER UNSCORABLE	0	0	2
ALLELE FREQUENCY	(A)0.702	(1) 0.972	(1) 0.072
	(B)0.298	(2) 0.026	(2) 0.364
		(3) 0.000	(3) 0.564
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRC B1	AA	0	1-1	10	1-1	0
16	AB	0	1-2	3	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	0	13	0
NUMBER UNSCORABLE	16	3	0
ALLELE FREQUENCY	(A)0.000	(1) 0.885	(1) 0.000
	(B)0.000	(2) 0.115	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRC B2	AA	0	1-1	10	1-1	0
16	AB	0	1-2	2	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	0	12	0
NUMBER UNSCORABLE	16	4	0
ALLELE FREQUENCY	(A)0.000	(1) 0.917	(1) 0.000
	(B)0.000	(2) 0.083	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRC C1	AA	58	1-1	91	1-1	0
100	AB	34	1-2	9	1-2	0
	BB	8	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	100	100	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.750	(1) 0.955	(1) 0.000
	(B)0.250	(2) 0.045	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.0C0

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRC C2	AA	60	1-1	91	1-1	0
100	AB	33	1-2	9	1-2	0
	BB	7	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	100	100	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.765	(1) 0.955	(1) 0.000
	(B)0.235	(2) 0.045	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRQ 1	AA	16	1-1	28	1-1	0
35	AB	14	1-2	3	1-2	0
	BB	1	1-3	0	1-3	2
			1-4	0	1-4	0
			2-2	0	2-2	7
			2-3	0	2-3	16
			2-4	0	2-4	0
			3-3	0	3-3	5
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	31	31	30
NUMBER UNSCORABLE	2	2	3
ALLELE FREQUENCY	(A)0.742	(1) 0.952	(1) 0.033
	(B)0.258	(2) 0.048	(2) 0.500
		(3) 0.000	(3) 0.467
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRQ 2	AA	41	1-1	53	1-1	0
70	AB	25	1-2	6	1-2	0
	BB	4	1-3	0	1-3	4
			1-4	1	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	29
			2-4	0	2-4	0
			3-3	0	3-3	11
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	70	60	68
NUMBER UNSCORABLE	0	10	2
ALLELE FREQUENCY	(A)0.764	(1) 0.942	(1) 0.029
	(B)0.236	(2) 0.050	(2) 0.566
		(3) 0.000	(3) 0.404
		(4) 0.008	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT	AA	37	1-1	65	1-1	0
70	AB	27	1-2	1	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	66	66	0
NUMBER UNSCORABLE	4	4	0
ALLELE FREQUENCY	(A)0.765	(1) 0.992	(1) 0.000
	(B)0.235	(2) 0.008	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT L1	AA	170	1-1	300	1-1	0
323	AB	113	1-2	13	1-2	2
	BB	34	1-3	0	1-3	3
			1-4	3	1-4	0
			2-2	1	2-2	4
			2-3	0	2-3	14
			2-4	0	2-4	0
			3-3	0	3-3	11
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	317	317	34
NUMBER UNSCORABLE	5	5	8
ALLELE FREQUENCY	(A)0.715	(1) 0.972	(1) 0.074
	(B)0.285	(2) 0.024	(2) 0.353
		(3) 0.000	(3) 0.574
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT L2	AA	83	1-1	157	1-1	0
168	AB	73	1-2	7	1-2	0
	BB	7	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	163	165	0
NUMBER UNSCORABLE	5	3	0
ALLELE FREQUENCY	(A)0.733	(1) 0.976	(1) 0.000
	(B)0.267	(2) 0.021	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT M1	AA	73	1-1	122	1-1	0
131	AB	48	1-2	6	1-2	0
	BB	10	1-3	0	1-3	0
			1-4	3	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	131	131	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.740	(1) 0.966	(1) 0.000
	(B)0.260	(2) 0.023	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.011	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT M2	AA	7	1-1	15	1-1	0
18	AB	9	1-2	2	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	18	17	0
NUMBER UNSCORABLE	0	1	0
ALLELE FREQUENCY	(A)0.639	(1) 0.941	(1) 0.000
	(B)0.361	(2) 0.059	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT N	AA	90	1-1	143	1-1	0
154	AB	55	1-2	7	1-2	0
	BB	7	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	1	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	152	152	0
NUMBER UNSCORABLE	2	2	0
ALLELE FREQUENCY	(A)0.773	(1) 0.967	(1) 0.000
	(B)0.227	(2) 0.026	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.007	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT P	AA	44	1-1	88	1-1	1
93	AB	40	1-2	3	1-2	4
	BB	6	1-3	1	1-3	9
			1-4	0	1-4	0
			2-2	0	2-2	7
			2-3	0	2-3	28
			2-4	0	2-4	0
			3-3	0	3-3	37
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	90	92	86
NUMBER UNSCORABLE	3	1	3
ALLELE FREQUENCY	(A)0.711	(1) 0.978	(1) 0.087
	(B)0.289	(2) 0.016	(2) 0.267
		(3) 0.005	(3) 0.645
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT Q	AA	153	1-1	254	1-1	1
267	AB	92	1-2	12	1-2	16
	BB	15	1-3	0	1-3	42
			1-4	0	1-4	0
			2-2	0	2-2	19
			2-3	0	2-3	87
			2-4	0	2-4	0
			3-3	0	3-3	92
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	260	266	257
NUMBER UNSCORABLE	7	1	10
ALLELE FREQUENCY	(A)0.765	(1) 0.977	(1) 0.117
	(B)0.235	(2) 0.023	(2) 0.274
		(3) 0.000	(3) 0.609
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT R1	AA	27	1-1	65	1-1	0
69	AB	32	1-2	2	1-2	7
	BB	8	1-3	0	1-3	8
			1-4	0	1-4	0
			2-2	0	2-2	2
			2-3	0	2-3	22
			2-4	0	2-4	0
			3-3	0	3-3	26
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	67	67	65
NUMBER UNSCORABLE	2	2	4
ALLELE FREQUENCY	(A)0.642	(1) 0.985	(1) 0.115
	(B)0.358	(2) 0.015	(2) 0.254
		(3) 0.000	(3) 0.631
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT R2	AA	87	1-1	163	1-1	4
174	AB	67	1-2	9	1-2	5
	BB	16	1-3	0	1-3	26
			1-4	0	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	57
			2-4	0	2-4	0
			3-3	0	3-3	58
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	170	172	163
NUMBER UNSCORABLE	4	2	11
ALLELE FREQUENCY	(A)0.709	(1) 0.974	(1) 0.120
	(B)0.291	(2) 0.026	(2) 0.270
		(3) 0.000	(3) 0.610
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT R3	AA	76	1-1	132	1-1	3
140	AB	56	1-2	5	1-2	11
	BB	6	1-3	1	1-3	12
			1-4	0	1-4	1
			2-2	0	2-2	10
			2-3	0	2-3	48
			2-4	0	2-4	0
			3-3	0	3-3	45
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	138	138	130
NUMBER UNSCORABLE	2	2	10
ALLELE FREQUENCY	(A)0.754	(1) 0.978	(1) 0.115
	(B)0.246	(2) 0.018	(2) 0.304
		(3) 0.004	(3) 0.577
		(4) 0.000	(4) 0.004

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT R4	AA	8	1-1	14	1-1	1
16	AB	6	1-2	1	1-2	1
	BB	1	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	1
			2-3	0	2-3	5
			2-4	0	2-4	0
			3-3	0	3-3	4
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST		PGI
TOTAL FISH SCORED	15	15		13
NUMBER UNSCORABLE	1	1		3
ALLELE FREQUENCY	(A)0.733	(1) 0.967	(1)	0.154
	(B)0.267	(2) 0.033	(2)	0.308
		(3) 0.000	(3)	0.538
		(4) 0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT R5	AA	19	1-1	29	1-1	0
32	AB	10	1-2	2	1-2	1
	BB	2	1-3	0	1-3	5
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	12
			2-4	0	2-4	0
			3-3	0	3-3	13
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST		PGI
TOTAL FISH SCORED	31	31		31
NUMBER UNSCORABLE	1	1		1
ALLELE FREQUENCY	(A)0.774	(1) 0.968	(1)	0.097
	(B)0.226	(2) 0.032	(2)	0.210
		(3) 0.000	(3)	0.694
		(4) 0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT S	AA	77	1-1	145	1-1	2
155	AB	58	1-2	4	1-2	11
	BB	15	1-3	0	1-3	12
			1-4	2	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	47
			2-4	0	2-4	0
			3-3	0	3-3	49
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST		PGI
TOTAL FISH SCORED	150	151		134
NUMBER UNSCORABLE	5	4		21
ALLELE FREQUENCY	(A)0.707	(1) 0.980	(1)	0.101
	(B)0.293	(2) 0.013	(2)	0.313
		(3) 0.000	(3)	0.586
		(4) 0.007	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT T	AA	40	1-1	62	1-1	1
66	AB	20	1-2	4	1-2	6
	BB	6	1-3	0	1-3	12
			1-4	0	1-4	0
			2-2	0	2-2	3
			2-3	0	2-3	24
			2-4	0	2-4	0
			3-3	0	3-3	20
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	66	66	66
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.758	(1) 0.970	(1) 0.152
	(B)0.242	(2) 0.030	(2) 0.273
		(3) 0.000	(3) 0.576
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT U	AA	74	1-1	120	1-1	2
126	AB	40	1-2	4	1-2	14
	BB	10	1-3	0	1-3	13
			1-4	1	1-4	0
			2-2	0	2-2	5
			2-3	0	2-3	44
			2-4	0	2-4	0
			3-3	0	3-3	45
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	124	125	123
NUMBER UNSCORABLE	2	1	3
ALLELE FREQUENCY	(A)0.758	(1) 0.980	(1) 0.126
	(B)0.242	(2) 0.016	(2) 0.276
		(3) 0.000	(3) 0.598
		(4) 0.004	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT V	AA	116	1-1	200	1-1	2
220	AB	80	1-2	10	1-2	11
	BB	14	1-3	0	1-3	29
			1-4	1	1-4	0
			2-2	0	2-2	19
			2-3	0	2-3	74
			2-4	0	2-4	0
			3-3	0	3-3	77
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	210	211	212
NUMBER UNSCORABLE	10	9	8
ALLELE FREQUENCY	(A)0.743	(1) 0.974	(1) 0.104
	(B)0.257	(2) 0.024	(2) 0.290
		(3) 0.000	(3) 0.606
		(4) 0.002	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT W	AA	10	1-1	22	1-1	0
23	AB	8	1-2	0	1-2	0
	BB	5	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	23	23	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.609	(1) 0.978	(1) 0.000
	(B)0.391	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.022	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRT XN	AA	22	1-1	35	1-1	0
37	AB	14	1-2	1	1-2	0
	BB	1	1-3	1	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	37	37	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.784	(1) 0.973	(1) 0.000
	(B)0.216	(2) 0.014	(2) 0.000
		(3) 0.014	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG 1	AA	13	1-1	19	1-1	0
20	AB	6	1-2	1	1-2	0
	BB	1	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	8
			2-3	0	2-3	11
			2-4	0	2-4	0
			3-3	0	3-3	1
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	20	20	20
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.800	(1) 0.975	(1) 0.000
	(B)0.200	(2) 0.025	(2) 0.675
		(3) 0.000	(3) 0.325
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG 2	AA	15	1-1	29	1-1	0
59	AB	14	1-2	1	1-2	0
	BB	1	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	11
			2-4	0	2-4	0
			3-3	0	3-3	1
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	30	30	29
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.733	(1) 0.983	(1) 0.017
	(B)0.267	(2) 0.017	(2) 0.741
		(3) 0.000	(3) 0.241
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 10	AA	46	1-1	97	1-1	3
295	AB	46	1-2	4	1-2	16
	BB	9	1-3	0	1-3	21
			1-4	0	1-4	1
			2-2	0	2-2	19
			2-3	0	2-3	64
			2-4	0	2-4	0
			3-3	0	3-3	64
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	101	101	188
NUMBER UNSCORABLE	6	6	0
ALLELE FREQUENCY	(A)0.683	(1) 0.980	(1) 0.117
	(B)0.317	(2) 0.020	(2) 0.314
		(3) 0.000	(3) 0.566
		(4) 0.000	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 12	AA	47	1-1	79	1-1	0
89	AB	33	1-2	5	1-2	0
	BB	6	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	86	86	0
NUMBER UNSCORABLE	3	3	0
ALLELE FREQUENCY	(A)0.738	(1) 0.953	(1) 0.000
	(B)0.262	(2) 0.041	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.006	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 27	AA	108	1-1	184	1-1	2
386	AB	75	1-2	14	1-2	12
	BB	16	1-3	0	1-3	21
			1-4	1	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	67
			2-4	0	2-4	0
			3-3	0	3-3	71
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	199		199		186
NUMBER UNSCORABLE	1		1		0
ALLELE FREQUENCY	(A)0.731	(1)	0.962	(1)	0.099
	(B)0.269	(2)	0.035	(2)	0.282
		(3)	0.000	(3)	0.618
		(4)	0.003	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 37	AA	99	1-1	185	1-1	3
396	AB	82	1-2	8	1-2	19
	BB	14	1-3	1	1-3	24
			1-4	1	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	66
			2-4	0	2-4	0
			3-3	0	3-3	71
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	195		195		195
NUMBER UNSCORABLE	6		6		0
ALLELE FREQUENCY	(A)0.718	(1)	0.974	(1)	0.126
	(B)0.282	(2)	0.021	(2)	0.279
		(3)	0.003	(3)	0.595
		(4)	0.003	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 42	AA	101	1-1	184	1-1	2
365	AB	81	1-2	10	1-2	13
	BB	16	1-3	1	1-3	16
			1-4	3	1-4	0
			2-2	0	2-2	17
			2-3	0	2-3	69
			2-4	0	2-4	0
			3-3	0	3-3	49
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	198		198		166
NUMBER UNSCORABLE	0		0		1
ALLELE FREQUENCY	(A)0.715	(1)	0.965	(1)	0.099
	(B)0.285	(2)	0.025	(2)	0.349
		(3)	0.003	(3)	0.551
		(4)	0.008	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 45	AA	116	1-1	189	1-1	0
394	AB	65	1-2	10	1-2	9
	BB	18	1-3	0	1-3	19
			1-4	0	1-4	0
			2-2	0	2-2	8
			2-3	0	2-3	73
			2-4	0	2-4	0
			3-3	0	3-3	86
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	199	199	195
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.746	(1) 0.975	(1) 0.072
	(B)0.254	(2) 0.025	(2) 0.251
		(3) 0.000	(3) 0.677
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PTW 52	AA	73	1-1	124	1-1	1
260	AB	50	1-2	6	1-2	16
	BB	9	1-3	1	1-3	16
			1-4	1	1-4	0
			2-2	0	2-2	8
			2-3	0	2-3	43
			2-4	0	2-4	0
			3-3	0	3-3	42
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	132	132	126
NUMBER UNSCORABLE	2	2	0
ALLELE FREQUENCY	(A)0.742	(1) 0.970	(1) 0.135
	(B)0.258	(2) 0.023	(2) 0.298
		(3) 0.004	(3) 0.567
		(4) 0.004	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SEP	AA	60	1-1	92	1-1	0
99	AB	35	1-2	5	1-2	0
	BB	4	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	1	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	99	98	0
NUMBER UNSCORABLE	0	1	0
ALLELE FREQUENCY	(A)0.783	(1) 0.964	(1) 0.000
	(B)0.217	(2) 0.036	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SEQ	AA	60	1-1	99	1-1	0
107	AB	41	1-2	7	1-2	0
	BB	5	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	106	106	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.759	(1) 0.967	(1) 0.000
	(B)0.241	(2) 0.033	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC A	AA	94	1-1	188	1-1	2
200	AB	86	1-2	10	1-2	11
	BB	20	1-3	1	1-3	23
			1-4	1	1-4	0
			2-2	0	2-2	19
			2-3	0	2-3	63
			2-4	0	2-4	0
			3-3	0	3-3	81
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.685	(1) 0.970	(1) 0.095
	(B)0.315	(2) 0.025	(2) 0.280
		(3) 0.002	(3) 0.623
		(4) 0.002	(4) 0.002

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC B	AA	109	1-1	188	1-1	0
200	AB	84	1-2	11	1-2	11
	BB	7	1-3	0	1-3	17
			1-4	1	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	75
			2-4	0	2-4	1
			3-3	0	3-3	72
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.755	(1) 0.970	(1) 0.070
	(B)0.245	(2) 0.027	(2) 0.338
		(3) 0.000	(3) 0.590
		(4) 0.002	(4) 0.002

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC C	AA	57	1-1	122	1-1	3
130	AB	60	1-2	6	1-2	9
	BB	12	1-3	0	1-3	10
			1-4	1	1-4	0
			2-2	0	2-2	8
			2-3	0	2-3	50
			2-4	0	2-4	0
			3-3	0	3-3	50
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	129	129	130
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.674	(1) 0.973	(1) 0.096
	(B)0.326	(2) 0.023	(2) 0.288
		(3) 0.000	(3) 0.615
		(4) 0.004	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC D	AA	109	1-1	185	1-1	2
200	AB	80	1-2	13	1-2	17
	BB	11	1-3	0	1-3	18
			1-4	2	1-4	0
			2-2	0	2-2	26
			2-3	0	2-3	81
			2-4	0	2-4	0
			3-3	0	3-3	56
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.745	(1) 0.962	(1) 0.097
	(B)0.255	(2) 0.032	(2) 0.375
		(3) 0.000	(3) 0.527
		(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC E	AA	54	1-1	123	1-1	3
130	AB	62	1-2	6	1-2	11
	BB	13	1-3	0	1-3	17
			1-4	0	1-4	0
			2-2	0	2-2	16
			2-3	0	2-3	51
			2-4	0	2-4	0
			3-3	0	3-3	32
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	129	129	130
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.659	(1) 0.977	(1) 0.131
	(B)0.341	(2) 0.023	(2) 0.362
		(3) 0.000	(3) 0.508
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNC F	AA	120	1-1	185	1-1	1
200	AB	64	1-2	12	1-2	15
	BB	16	1-3	0	1-3	21
			1-4	3	1-4	0
			2-2	0	2-2	14
			2-3	0	2-3	73
			2-4	0	2-4	0
			3-3	0	3-3	76
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	200
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.760	(1) 0.962	(1) 0.095
	(B)0.240	(2) 0.030	(2) 0.290
		(3) 0.000	(3) 0.615
		(4) 0.007	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNL A	AA	25	1-1	0	1-1	0
50	AB	22	1-2	0	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	50	0	0
NUMBER UNSCORABLE	0	50	0
ALLELE FREQUENCY	(A)0.720	(1) 0.000	(1) 0.000
	(B)0.280	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNL AB	AA	59	1-1	93	1-1	1
191	AB	31	1-2	0	1-2	4
	BB	3	1-3	0	1-3	9
			1-4	0	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	33
			2-4	0	2-4	1
			3-3	0	3-3	34
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	93	93	94
NUMBER UNSCORABLE	3	3	1
ALLELE FREQUENCY	(A)0.801	(1) 1.000	(1) 0.080
	(B)0.199	(2) 0.000	(2) 0.330
		(3) 0.000	(3) 0.585
		(4) 0.000	(4) 0.005

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNL B	AA	30	1-1	49	1-1	0
50	AB	16	1-2	0	1-2	2
	BB	3	1-3	0	1-3	10
			1-4	0	1-4	0
			2-2	0	2-2	3
			2-3	0	2-3	17
			2-4	0	2-4	0
			3-3	0	3-3	18
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	49	49	50
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(A)0.776	(1) 1.000	(1) 0.120
	(B)0.224	(2) 0.000	(2) 0.250
		(3) 0.000	(3) 0.630
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SNL C	AA	73	1-1	136	1-1	3
221	AB	50	1-2	0	1-2	6
	BB	13	1-3	0	1-3	20
			1-4	0	1-4	0
			2-2	0	2-2	17
			2-3	0	2-3	39
			2-4	0	2-4	0
			3-3	0	3-3	48
			3-4	0	3-4	0
			4-4	0	4-4	0
					0-3	1

TOTAL FISH SCORED	TFN	EST	PGI
	136	136	134
NUMBER UNSCORABLE	0	0	1
ALLELE FREQUENCY	(A)0.721	(1) 1.000	(1) 0.119
	(B)0.279	(2) 0.000	(2) 0.295
		(3) 0.000	(3) 0.582
		(4) 0.000	(4) 0.000
			(0) 0.004

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
STA	AA	46	1-1	12	1-1	0
79	AB	25	1-2	1	1-2	0
	BB	5	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	76	13	0
NUMBER UNSCORABLE	3	66	0
ALLELE FREQUENCY	(A)0.770	(1) 0.962	(1) 0.000
	(B)0.230	(2) 0.038	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
STI	AA	96	1-1	0	1-1	0
200	AB	91	1-2	0	1-2	0
	BB	10	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	197	0	0
NUMBER UNSCORABLE	3	200	0
ALLELE FREQUENCY	(A)0.718	(1) 0.000	(1) 0.000
	(B)0.282	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
STS 1	AA	98	1-1	0	1-1	0
190	AB	78	1-2	1	1-2	0
	BB	11	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	187	1	0
NUMBER UNSCORABLE	3	189	0
ALLELE FREQUENCY	(A)0.733	(1) 0.500	(1) 0.000
	(B)0.267	(2) 0.500	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
STS 2	AA	11	1-1	0	1-1	0
22	AB	11	1-2	0	1-2	0
	BB	0	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	22	0	0
NUMBER UNSCORABLE	0	22	0
ALLELE FREQUENCY	(A)0.750	(1) 0.000	(1) 0.000
	(B)0.250	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR A	AA	71	1-1	149	1-1	2
260	AB	53	1-2	3	1-2	12
	BB	12	1-3	0	1-3	25
			1-4	0	1-4	0
			2-2	0	2-2	7
			2-3	0	2-3	51
			2-4	0	2-4	0
			3-3	0	3-3	48
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	136	152	145
NUMBER UNSCORABLE	19	3	10
ALLELE FREQUENCY	(A)0.717	(1) 0.990	(1) 0.141
	(B)0.283	(2) 0.010	(2) 0.266
		(3) 0.000	(3) 0.593
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR C	AA	22	1-1	41	1-1	0
41	AB	16	1-2	0	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	41	41	0
NUMBER UNSCORABLE	0	0	41
ALLELE FREQUENCY	(A)0.732	(1) 1.000	(1) 0.000
	(B)0.268	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR D	AA	105	1-1	194	1-1	0
348	AB	79	1-2	1	1-2	8
	BB	11	1-3	0	1-3	30
			1-4	0	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	65
			2-4	0	2-4	1
			3-3	0	3-3	77
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	195	195	194
NUMBER UNSCORABLE	4	4	5
ALLELE FREQUENCY	(A)0.741	(1) 0.997	(1) 0.098
	(B)0.259	(2) 0.003	(2) 0.258
		(3) 0.000	(3) 0.642
		(4) 0.000	(4) 0.003

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR E	AA	102	1-1	192	1-1	1
303	AB	82	1-2	5	1-2	4
	BB	13	1-3	0	1-3	17
			1-4	0	1-4	0
			2-2	0	2-2	13
			2-3	0	2-3	54
			2-4	0	2-4	0
			3-3	0	3-3	62
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	197	197	151
NUMBER UNSCORABLE	3	3	2
ALLELE FREQUENCY	(A)0.726	(1) 0.987	(1) 0.076
	(B)0.274	(2) 0.013	(2) 0.278
		(3) 0.000	(3) 0.646
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR E1	AA	26	1-1	0	1-1	0
122	AB	31	1-2	0	1-2	3
	BB	4	1-3	0	1-3	7
			1-4	0	1-4	0
			2-2	0	2-2	4
			2-3	0	2-3	27
			2-4	0	2-4	0
			3-3	0	3-3	19
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	61	0	60
NUMBER UNSCORABLE	0	61	1
ALLELE FREQUENCY	(A)0.680	(1) 0.000	(1) 0.083
	(B)0.320	(2) 0.000	(2) 0.317
		(3) 0.000	(3) 0.600
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR F	AA	110	1-1	3	1-1	0
310	AB	64	1-2	0	1-2	13
	BB	5	1-3	0	1-3	23
			1-4	0	1-4	0
			2-2	0	2-2	17
			2-3	0	2-3	69
			2-4	0	2-4	0
			3-3	0	3-3	57
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	179	3	179
NUMBER UNSCORABLE	1	177	1
ALLELE FREQUENCY	(A)0.793	(1) 1.000	(1) 0.101
	(B)0.207	(2) 0.000	(2) 0.324
		(3) 0.000	(3) 0.575
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR H	AA	41	1-1	0	1-1	0
74	AB	31	1-2	0	1-2	0
	BB	2	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	74	0	0
NUMBER UNSCORABLE	0	74	0
ALLELE FREQUENCY	(A)0.764	(1) 0.000	(1) 0.000
	(B)0.236	(2) 0.000	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR I	AA	119	1-1	112	1-1	0
350	AB	72	1-2	6	1-2	12
	BB	9	1-3	0	1-3	20
			1-4	0	1-4	0
			2-2	0	2-2	12
			2-3	0	2-3	86
			2-4	0	2-4	0
			3-3	0	3-3	68
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	118	198
NUMBER UNSCORABLE	0	82	2
ALLELE FREQUENCY	(A)0.775	(1) 0.975	(1) 0.081
	(B)0.225	(2) 0.025	(2) 0.308
		(3) 0.000	(3) 0.611
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TRD	AA	92	1-1	184	1-1	0
198	AB	63	1-2	11	1-2	0
	BB	15	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	0
			2-3	0	2-3	0
			2-4	0	2-4	0
			3-3	0	3-3	0
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	170	196	0
NUMBER UNSCORABLE	28	2	0
ALLELE FREQUENCY	(A)0.726	(1) 0.969	(1) 0.000
	(B)0.274	(2) 0.028	(2) 0.000
		(3) 0.000	(3) 0.000
		(4) 0.003	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
XX	AA	207	1-1	321	1-1	2
694	AB	119	1-2	22	1-2	22
	BB	22	1-3	0	1-3	42
			1-4	5	1-4	0
			2-2	0	2-2	28
			2-3	0	2-3	128
			2-4	0	2-4	0
			3-3	0	3-3	119
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	348	348	341
NUMBER UNSCORABLE	1	1	4
ALLELE FREQUENCY	(A)0.766	(1) 0.961	(1) 0.100
	(B)0.234	(2) 0.032	(2) 0.302
		(3) 0.000	(3) 0.598
		(4) 0.007	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
XXY	AA	22	1-1	49	1-1	2
51	AB	22	1-2	2	1-2	1
	BB	7	1-3	0	1-3	8
			1-4	0	1-4	0
			2-2	0	2-2	5
			2-3	0	2-3	17
			2-4	0	2-4	0
			3-3	0	3-3	18
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	51	51	51
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.647	(1) 0.980	(1) 0.127
	(B)0.353	(2) 0.020	(2) 0.275
		(3) 0.000	(3) 0.598
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
XXZ	AA	20	1-1	44	1-1	1
51	AB	23	1-2	6	1-2	1
	BB	8	1-3	1	1-3	6
			1-4	0	1-4	0
			2-2	0	2-2	7
			2-3	0	2-3	18
			2-4	0	2-4	0
			3-3	0	3-3	18
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	51	51	51
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.618	(1) 0.931	(1) 0.088
	(B)0.382	(2) 0.059	(2) 0.324
		(3) 0.010	(3) 0.588
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP A1	AA	22	1-1	56	1-1	0
63	AB	29	1-2	4	1-2	2
	BB	9	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	0	2-2	24
			2-3	0	2-3	31
			2-4	0	2-4	0
			3-3	0	3-3	3
			3-4	0	3-4	1
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	60	60	61
NUMBER UNSCORABLE	3	3	2
ALLELE FREQUENCY	(A)0.608	(1) 0.967	(1) 0.016
	(B)0.392	(2) 0.033	(2) 0.664
		(3) 0.000	(3) 0.311
		(4) 0.000	(4) 0.008

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP A2	AA	70	1-1	125	1-1	0
130	AB	50	1-2	5	1-2	2
	BB	10	1-3	0	1-3	1
			1-4	0	1-4	0
			2-2	0	2-2	62
			2-3	0	2-3	51
			2-4	0	2-4	0
			3-3	0	3-3	14
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	130	130	130
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.731	(1) 0.981	(1) 0.012
	(B)0.269	(2) 0.019	(2) 0.681
		(3) 0.000	(3) 0.308
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP D1	AA	30	1-1	53	1-1	0
56	AB	22	1-2	1	1-2	0
	BB	3	1-3	0	1-3	0
			1-4	0	1-4	0
			2-2	1	2-2	28
			2-3	0	2-3	22
			2-4	0	2-4	0
			3-3	0	3-3	5
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	55	55	55
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.745	(1) 0.973	(1) 0.000
	(B)0.255	(2) 0.027	(2) 0.709
		(3) 0.000	(3) 0.291
		(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP D2	AA	61	1-1	105	1-1	0
112	AB	42	1-2	5	1-2	1
	BB	8	1-3	0	1-3	2
			1-4	1	1-4	0
			2-2	0	2-2	51
			2-3	0	2-3	47
			2-4	0	2-4	0
			3-3	0	3-3	11
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	111		111		112
NUMBER UNSCORABLE	1		1		0
ALLELE FREQUENCY	(A)0.739	(1)	0.973	(1)	0.013
	(B)0.261	(2)	0.023	(2)	0.670
		(3)	0.000	(3)	0.317
		(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP H	AA	97	1-1	187	1-1	0
199	AB	85	1-2	9	1-2	7
	BB	17	1-3	0	1-3	1
			1-4	3	1-4	0
			2-2	0	2-2	89
			2-3	0	2-3	82
			2-4	0	2-4	0
			3-3	0	3-3	20
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	199		199		199
NUMBER UNSCORABLE	0		0		0
ALLELE FREQUENCY	(A)0.701	(1)	0.970	(1)	0.020
	(B)0.299	(2)	0.023	(2)	0.671
		(3)	0.000	(3)	0.309
		(4)	0.008	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP I	AA	61	1-1	102	1-1	0
109	AB	40	1-2	6	1-2	1
	BB	8	1-3	0	1-3	0
			1-4	1	1-4	0
			2-2	0	2-2	47
			2-3	0	2-3	52
			2-4	0	2-4	0
			3-3	0	3-3	9
			3-4	0	3-4	0
			4-4	0	4-4	0

	TFN		EST		PGI
TOTAL FISH SCORED	109		109		109
NUMBER UNSCORABLE	0		0		0
ALLELE FREQUENCY	(A)0.743	(1)	0.968	(1)	0.005
	(B)0.257	(2)	0.028	(2)	0.674
		(3)	0.000	(3)	0.321
		(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP J	AA	64	1-1	118	1-1	0
127	AB	53	1-2	8	1-2	3
	BB	10	1-3	0	1-3	2
			1-4	1	1-4	0
			2-2	0	2-2	68
			2-3	0	2-3	43
			2-4	0	2-4	1
			3-3	0	3-3	10
			3-4	0	3-4	0
			4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	127	127	127
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(A)0.713	(1) 0.965	(1) 0.020
	(B)0.287	(2) 0.031	(2) 0.720
		(3) 0.000	(3) 0.256
		(4) 0.004	(4) 0.004

APPENDIX 7.

Summary of the phenotypic scores of the skipjack samples.

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
AP A	1-1	0	1-1	0	1-1	0
172	1-2	3	1-2	0	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	82	2-2	79	2-2	0
	2-3	68	2-3	66	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	18	3-3	24	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		171		171		0
NUMBER UNSCORABLE		1		1		0
ALLELE FREQUENCY	(1)	0.009	(1)	0.000	(1)	0.000
	(2)	0.687	(2)	0.661	(2)	0.000
	(3)	0.304	(3)	0.333	(3)	0.000
	(4)	0.000	(4)	0.006	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC B	1-1	0	1-1	0	1-1	0
200	1-2	1	1-2	0	1-2	0
	1-3	2	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	116	2-2	29	2-2	0
	2-3	72	2-3	91	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	8	3-3	72	3-3	0
	3-4	0	3-4	4	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		199		199		0
NUMBER UNSCORABLE		1		1		0
ALLELE FREQUENCY	(1)	0.008	(1)	0.003	(1)	0.000
	(2)	0.766	(2)	0.379	(2)	0.000
	(3)	0.226	(3)	0.603	(3)	0.000
	(4)	0.000	(4)	0.015	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC C	1-1	0	1-1	0	1-1	0
200	1-2	2	1-2	0	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	95	2-2	30	2-2	0
	2-3	83	2-3	87	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	18	3-3	69	3-3	0
	3-4	0	3-4	10	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		198		198		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.005	(1)	0.003	(1)	0.000
	(2)	0.694	(2)	0.374	(2)	0.000
	(3)	0.301	(3)	0.596	(3)	0.000
	(4)	0.000	(4)	0.028	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC D	1-1	0	1-1	0	1-1	0
200	1-2	5	1-2	0	1-2	0
	1-3	3	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	94	2-2	26	2-2	0
	2-3	85	2-3	93	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	12	3-3	73	3-3	0
	3-4	0	3-4	4	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	199	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(1) 0.020	(1) 0.003	(1) 0.000
	(2) 0.698	(2) 0.369	(2) 0.000
	(3) 0.281	(3) 0.613	(3) 0.000
	(4) 0.000	(4) 0.015	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC E	1-1	0	1-1	0	1-1	0
200	1-2	1	1-2	0	1-2	0
	1-3	4	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	87	2-2	53	2-2	0
	2-3	91	2-3	97	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	17	3-3	45	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	200	200	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(1) 0.013	(1) 0.002	(1) 0.000
	(2) 0.665	(2) 0.512	(2) 0.000
	(3) 0.322	(3) 0.475	(3) 0.000
	(4) 0.000	(4) 0.010	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC F	1-1	0	1-1	0	1-1	0
200	1-2	3	1-2	0	1-2	0
	1-3	1	1-3	3	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	109	2-2	49	2-2	0
	2-3	74	2-3	91	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	12	3-3	52	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	199	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(1) 0.010	(1) 0.008	(1) 0.000
	(2) 0.741	(2) 0.480	(2) 0.000
	(3) 0.249	(3) 0.503	(3) 0.000
	(4) 0.000	(4) 0.010	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC G	1-1	0	1-1	0	1-1	0
200	1-2	7	1-2	0	1-2	0
	1-3	4	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	89	2-2	38	2-2	0
	2-3	83	2-3	106	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	17	3-3	45	3-3	0
	3-4	0	3-4	7	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		200		200		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.027	(1)	0.005	(1)	0.000
	(2)	0.670	(2)	0.460	(2)	0.000
	(3)	0.303	(3)	0.512	(3)	0.000
	(4)	0.000	(4)	0.023	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC H	1-1	0	1-1	0	1-1	0
200	1-2	4	1-2	2	1-2	0
	1-3	2	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	98	2-2	35	2-2	0
	2-3	82	2-3	96	2-3	0
	2-4	0	2-4	4	2-4	0
	3-3	13	3-3	58	3-3	0
	3-4	0	3-4	4	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		199		199		0
NUMBER UNSCORABLE		1		1		0
ALLELE FREQUENCY	(1)	0.015	(1)	0.005	(1)	0.000
	(2)	0.709	(2)	0.432	(2)	0.000
	(3)	0.276	(3)	0.543	(3)	0.000
	(4)	0.000	(4)	0.020	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
EC I	1-1	0	1-1	0	1-1	0
200	1-2	2	1-2	0	1-2	0
	1-3	2	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	82	2-2	31	2-2	0
	2-3	97	2-3	101	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	15	3-3	64	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		198		198		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.010	(1)	0.000	(1)	0.000
	(2)	0.664	(2)	0.414	(2)	0.000
	(3)	0.326	(3)	0.581	(3)	0.000
	(4)	0.000	(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
JOHN F	1-1	0	1-1	0	1-1	0
139	1-2	0	1-2	4	1-2	0
	1-3	2	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	65	2-2	62	2-2	0
	2-3	59	2-3	59	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	12	3-3	10	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		138		138		0
NUMBER UNSCORABLE		1		1		0
ALLELE FREQUENCY	(1)	0.007	(1)	0.022	(1)	0.000
	(2)	0.685	(2)	0.681	(2)	0.000
	(3)	0.308	(3)	0.293	(3)	0.000
	(4)	0.000	(4)	0.004	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
KA	1-1	0	1-1	0	1-1	0
153	1-2	0	1-2	0	1-2	0
	1-3	1	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	70	2-2	36	2-2	0
	2-3	69	2-3	77	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	11	3-3	33	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		151		151		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.003	(1)	0.003	(1)	0.000
	(2)	0.692	(2)	0.500	(2)	0.000
	(3)	0.305	(3)	0.483	(3)	0.000
	(4)	0.000	(4)	0.013	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
KB	1-1	0	1-1	0	1-1	0
162	1-2	3	1-2	0	1-2	0
	1-3	2	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	77	2-2	31	2-2	0
	2-3	60	2-3	75	2-3	0
	2-4	0	2-4	5	2-4	0
	3-3	19	3-3	47	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		161		161		0
NUMBER UNSCORABLE		1		1		0
ALLELE FREQUENCY	(1)	0.016	(1)	0.003	(1)	0.000
	(2)	0.674	(2)	0.441	(2)	0.000
	(3)	0.311	(3)	0.534	(3)	0.000
	(4)	0.000	(4)	0.022	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
KC	1-1	0	1-1	0	1-1	0
136	1-2	2	1-2	0	1-2	0
	1-3	0	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	59	2-2	29	2-2	0
	2-3	64	2-3	68	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	11	3-3	30	3-3	0
	3-4	0	3-4	6	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		136		136		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.007	(1)	0.007	(1)	0.000
	(2)	0.676	(2)	0.467	(2)	0.000
	(3)	Q.316	(3)	0.500	(3)	0.000
	(4)	0.000	(4)	0.026	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME A	1-1	0	1-1	0	1-1	0
200	1-2	2	1-2	2	1-2	0
	1-3	3	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	98	2-2	80	2-2	0
	2-3	85	2-3	91	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	12	3-3	23	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		200		200		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.013	(1)	0.007	(1)	0.000
	(2)	0.707	(2)	0.637	(2)	0.000
	(3)	0.280	(3)	0.347	(3)	0.000
	(4)	0.000	(4)	0.007	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME D	1-1	0	1-1	0	1-1	0
198	1-2	1	1-2	2	1-2	0
	1-3	4	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	82	2-2	70	2-2	0
	2-3	88	2-3	90	2-3	0
	2-4	0	2-4	3	2-4	0
	3-3	20	3-3	28	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		195		195		0
NUMBER UNSCORABLE		3		3		0
ALLELE FREQUENCY	(1)	0.013	(1)	0.005	(1)	0.000
	(2)	0.649	(2)	0.603	(2)	0.000
	(3)	0.338	(3)	0.379	(3)	0.000
	(4)	0.000	(4)	0.013	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ME G	1-1	0	1-1	0	1-1	0
100	1-2	1	1-2	2	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	48	2-2	44	2-2	0
	2-3	45	2-3	44	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	4	3-3	9	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	99	100	0
NUMBER UNSCORABLE	1	0	0
ALLELE FREQUENCY	(1) 0.010	(1) 0.010	(1) 0.000
	(2) 0.717	(2) 0.670	(2) 0.000
	(3) 0.273	(3) 0.315	(3) 0.000
	(4) 0.000	(4) 0.005	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK A1	1-1	0	1-1	0	1-1	0
200	1-2	2	1-2	0	1-2	0
	1-3	1	1-3	1	1-3	0
	1-4	0	1-4	1	1-4	0
	2-2	98	2-2	42	2-2	0
	2-3	77	2-3	98	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	21	3-3	53	3-3	0
	3-4	0	3-4	3	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	199	199	0
NUMBER UNSCORABLE	1	1	0
ALLELE FREQUENCY	(1) 0.008	(1) 0.005	(1) 0.000
	(2) 0.691	(2) 0.460	(2) 0.000
	(3) 0.302	(3) 0.523	(3) 0.000
	(4) 0.000	(4) 0.013	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK A2	1-1	0	1-1	0	1-1	0
198	1-2	4	1-2	1	1-2	0
	1-3	4	1-3	3	1-3	0
	1-4	0	1-4	1	1-4	0
	2-2	76	2-2	38	2-2	0
	2-3	91	2-3	110	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	19	3-3	37	3-3	0
	3-4	0	3-4	4	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN	EST	PGI
TOTAL FISH SCORED	194	196	0
NUMBER UNSCORABLE	4	2	0
ALLELE FREQUENCY	(1) 0.021	(1) 0.013	(1) 0.000
	(2) 0.637	(2) 0.482	(2) 0.000
	(3) 0.343	(3) 0.487	(3) 0.000
	(4) 0.000	(4) 0.018	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK C	1-1	0	1-1	0	1-1	0
200	1-2	8	1-2	1	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	90	2-2	42	2-2	0
	2-3	80	2-3	81	2-3	0
	2-4	0	2-4	4	2-4	0
	3-3	22	3-3	70	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		200		200		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.020	(1)	0.005	(1)	0.000
	(2)	0.670	(2)	0.425	(2)	0.000
	(3)	0.310	(3)	0.558	(3)	0.000
	(4)	0.000	(4)	0.013	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MK D	1-1	0	1-1	0	1-1	0
199	1-2	0	1-2	1	1-2	0
	1-3	2	1-3	4	1-3	0
	1-4	0	1-4	1	1-4	0
	2-2	93	2-2	44	2-2	0
	2-3	77	2-3	91	2-3	0
	2-4	0	2-4	3	2-4	0
	3-3	17	3-3	43	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		189		189		0
NUMBER UNSCORABLE		10		10		0
ALLELE FREQUENCY	(1)	0.005	(1)	0.016	(1)	0.000
	(2)	0.696	(2)	0.484	(2)	0.000
	(3)	0.299	(3)	0.484	(3)	0.000
	(4)	0.000	(4)	0.016	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
MRQ	1-1	0	1-1	0	1-1	0
93	1-2	2	1-2	1	1-2	0
	1-3	2	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	40	2-2	19	2-2	0
	2-3	36	2-3	37	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	8	3-3	32	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		88		92		0
NUMBER UNSCORABLE		5		1		0
ALLELE FREQUENCY	(1)	0.023	(1)	0.016	(1)	0.000
	(2)	0.670	(2)	0.418	(2)	0.000
	(3)	0.307	(3)	0.560	(3)	0.000
	(4)	0.000	(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
NZ A	1-1	0	1-1	0	1-1	0
197	1-2	4	1-2	0	1-2	0
	1-3	1	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	105	2-2	55	2-2	0
	2-3	69	2-3	94	2-3	0
	2-4	0	2-4	4	2-4	0
	3-3	16	3-3	39	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI
		195		195	0
NUMBER UNSCORABLE		2		2	0
ALLELE FREQUENCY	(1)	0.013	(1) 0.003	(1)	0.000
	(2)	0.726	(2) 0.533	(2)	0.000
	(3)	0.262	(3) 0.449	(3)	0.000
	(4)	0.000	(4) 0.015	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
NZ B	1-1	0	1-1	0	1-1	0
199	1-2	2	1-2	0	1-2	0
	1-3	3	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	100	2-2	65	2-2	0
	2-3	79	2-3	95	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	13	3-3	35	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI
		197		197	0
NUMBER UNSCORABLE		2		2	0
ALLELE FREQUENCY	(1)	0.013	(1) 0.000	(1)	0.000
	(2)	0.713	(2) 0.574	(2)	0.000
	(3)	0.274	(3) 0.421	(3)	0.000
	(4)	0.000	(4) 0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
NZOO 1	1-1	0	1-1	0	1-1	0
126	1-2	2	1-2	0	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	56	2-2	37	2-2	0
	2-3	58	2-3	67	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	10	3-3	22	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI
		126		126	0
NUMBER UNSCORABLE		0		0	0
ALLELE FREQUENCY	(1)	0.008	(1) 0.000	(1)	0.000
	(2)	0.683	(2) 0.560	(2)	0.000
	(3)	0.310	(3) 0.440	(3)	0.000
	(4)	0.000	(4) 0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
NZOO 2	1-1	0	1-1	0	1-1	0
69	1-2	0	1-2	1	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	28	2-2	21	2-2	0
	2-3	31	2-3	29	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	10	3-3	17	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		69		69		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.007	(1)	0.000
	(2)	0.630	(2)	0.522	(2)	0.000
	(3)	0.370	(3)	0.464	(3)	0.000
	(4)	0.000	(4)	0.007	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
NZOO 3	1-1	0	1-1	0	1-1	0
30	1-2	0	1-2	0	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	13	2-2	10	2-2	0
	2-3	12	2-3	17	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	4	3-3	2	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		29		29		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.000	(1)	0.000
	(2)	0.655	(2)	0.638	(2)	0.000
	(3)	0.345	(3)	0.362	(3)	0.000
	(4)	0.000	(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG A	1-1	0	1-1	0	1-1	0
147	1-2	0	1-2	1	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	81	2-2	64	2-2	0
	2-3	53	2-3	64	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	12	3-3	16	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		146		146		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.007	(1)	0.000
	(2)	0.736	(2)	0.661	(2)	0.000
	(3)	0.264	(3)	0.332	(3)	0.000
	(4)	0.000	(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG B	1-1	0	1-1	0	1-1	0
163	1-2	1	1-2	0	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	88	2-2	68	2-2	0
	2-3	62	2-3	66	2-3	0
	2-4	0	2-4	4	2-4	0
	3-3	9	3-3	25	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		161		163		0
NUMBER UNSCORABLE		2		0		0
ALLELE FREQUENCY	(1)	0.006	(1)	0.000	(1)	0.000
	(2)	0.742	(2)	0.632	(2)	0.000
	(3)	0.252	(3)	0.356	(3)	0.000
	(4)	0.000	(4)	0.012	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG NH	1-1	0	1-1	0	1-1	0
180	1-2	4	1-2	4	1-2	0
	1-3	1	1-3	6	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	87	2-2	63	2-2	0
	2-3	79	2-3	79	2-3	0
	2-4	0	2-4	5	2-4	0
	3-3	7	3-3	20	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		178		178		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.014	(1)	0.028	(1)	0.000
	(2)	0.722	(2)	0.601	(2)	0.000
	(3)	0.264	(3)	0.354	(3)	0.000
	(4)	0.000	(4)	0.017	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG Y	1-1	0	1-1	0	1-1	0
148	1-2	0	1-2	0	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	62	2-2	62	2-2	0
	2-3	65	2-3	67	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	18	3-3	15	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		146		146		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.003	(1)	0.000	(1)	0.000
	(2)	0.647	(2)	0.661	(2)	0.000
	(3)	0.349	(3)	0.332	(3)	0.000
	(4)	0.000	(4)	0.007	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
PNG Z	1-1	0	1-1	0	1-1	0
187	1-2	0	1-2	1	1-2	0
	1-3	4	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	90	2-2	103	2-2	0
	2-3	72	2-3	56	2-3	0
	2-4	0	2-4	3	2-4	0
	3-3	13	3-3	14	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		179		179		0
NUMBER UNSCORABLE		8		8		0
ALLELE FREQUENCY	(1)	0.011	(1)	0.008	(1)	0.000
	(2)	0.704	(2)	0.743	(2)	0.000
	(3)	0.285	(3)	0.240	(3)	0.000
	(4)	0.000	(4)	0.008	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
S218	1-1	0	1-1	0	1-1	0
124	1-2	0	1-2	0	1-2	0
	1-3	2	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	59	2-2	35	2-2	0
	2-3	53	2-3	63	2-3	0
	2-4	0	2-4	3	2-4	0
	3-3	10	3-3	21	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		124		123		0
NUMBER UNSCORABLE		0		1		0
ALLELE FREQUENCY	(1)	0.008	(1)	0.004	(1)	0.000
	(2)	0.690	(2)	0.553	(2)	0.000
	(3)	0.302	(3)	0.431	(3)	0.000
	(4)	0.000	(4)	0.012	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
S223	1-1	0	1-1	0	1-1	0
200	1-2	5	1-2	0	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	103	2-2	63	2-2	0
	2-3	76	2-3	107	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	13	3-3	26	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		198		198		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.015	(1)	0.000	(1)	0.000
	(2)	0.725	(2)	0.588	(2)	0.000
	(3)	0.260	(3)	0.407	(3)	0.000
	(4)	0.000	(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
SC SG	1-1	0	1-1	0	1-1	0
201	1-2	7	1-2	0	1-2	0
	1-3	3	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	85	2-2	39	2-2	0
	2-3	90	2-3	100	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	16	3-3	56	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		201		201		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.025	(1)	0.005	(1)	0.000
	(2)	0.664	(2)	0.448	(2)	0.000
	(3)	0.311	(3)	0.537	(3)	0.000
	(4)	0.000	(4)	0.010	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR B1	1-1	0	1-1	0	1-1	0
157	1-2	0	1-2	2	1-2	0
	1-3	0	1-3	3	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	17	2-2	32	2-2	0
	2-3	66	2-3	77	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	63	3-3	32	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		146		146		0
NUMBER UNSCORABLE		11		11		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.017	(1)	0.000
	(2)	0.342	(2)	0.490	(2)	0.000
	(3)	0.658	(3)	0.493	(3)	0.000
	(4)	0.000	(4)	0.000	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR B2	1-1	0	1-1	0	1-1	0
157	1-2	0	1-2	0	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	63	2-2	32	2-2	0
	2-3	66	2-3	77	2-3	0
	2-4	0	2-4	3	2-4	0
	3-3	17	3-3	32	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

	TFN		EST		PGI	
TOTAL FISH SCORED		146		146		0
NUMBER UNSCORABLE		11		11		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.000	(1)	0.000
	(2)	0.658	(2)	0.493	(2)	0.000
	(3)	0.342	(3)	0.490	(3)	0.000
	(4)	0.000	(4)	0.017	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR G	1-1	1	1-1	0	1-1	0
21	1-2	0	1-2	0	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	4	2-2	0	2-2	0
	2-3	14	2-3	11	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	2	3-3	6	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	21	21	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(1) 0.048	(1) 0.024	(1) 0.000
	(2) 0.524	(2) 0.286	(2) 0.000
	(3) 0.429	(3) 0.619	(3) 0.000
	(4) 0.000	(4) 0.071	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR G1	1-1	0	1-1	0	1-1	0
21	1-2	0	1-2	2	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	2	2-2	6	2-2	0
	2-3	14	2-3	11	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	5	3-3	0	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	21	21	0
NUMBER UNSCORABLE	0	0	0
ALLELE FREQUENCY	(1) 0.000	(1) 0.071	(1) 0.000
	(2) 0.429	(2) 0.619	(2) 0.000
	(3) 0.571	(3) 0.286	(3) 0.000
	(4) 0.000	(4) 0.024	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR G2	1-1	0	1-1	0	1-1	0
200	1-2	0	1-2	1	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	18	2-2	54	2-2	0
	2-3	83	2-3	106	2-3	0
	2-4	1	2-4	0	2-4	0
	3-3	96	3-3	37	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN	EST	PGI
	198	198	0
NUMBER UNSCORABLE	2	2	0
ALLELE FREQUENCY	(1) 0.000	(1) 0.003	(1) 0.000
	(2) 0.303	(2) 0.543	(2) 0.000
	(3) 0.694	(3) 0.455	(3) 0.000
	(4) 0.003	(4) 0.000	(4) 0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
TAR G3	1-1	0	1-1	0	1-1	0
200	1-2	0	1-2	0	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	95	2-2	37	2-2	0
	2-3	84	2-3	106	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	18	3-3	54	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		198		198		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.003	(1)	0.000	(1)	0.000
	(2)	0.692	(2)	0.455	(2)	0.000
	(3)	0.306	(3)	0.543	(3)	0.000
	(4)	0.000	(4)	0.003	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP B	1-1	0	1-1	0	1-1	0
198	1-2	4	1-2	0	1-2	0
	1-3	1	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	87	2-2	71	2-2	0
	2-3	82	2-3	98	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	24	3-3	25	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		198		198		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.013	(1)	0.003	(1)	0.000
	(2)	0.657	(2)	0.611	(2)	0.000
	(3)	0.331	(3)	0.379	(3)	0.000
	(4)	0.000	(4)	0.008	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP C	1-1	0	1-1	0	1-1	0
189	1-2	3	1-2	3	1-2	0
	1-3	0	1-3	1	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	92	2-2	101	2-2	0
	2-3	79	2-3	74	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	15	3-3	9	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		189		189		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.008	(1)	0.011	(1)	0.000
	(2)	0.704	(2)	0.741	(2)	0.000
	(3)	0.288	(3)	0.246	(3)	0.000
	(4)	0.000	(4)	0.003	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP EA	1-1	0	1-1	0	1-1	0
36	1-2	0	1-2	2	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	12	2-2	19	2-2	0
	2-3	21	2-3	11	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	3	3-3	3	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		36		36		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.000	(1)	0.028	(1)	0.000
	(2)	0.625	(2)	0.722	(2)	0.000
	(3)	0.375	(3)	0.236	(3)	0.000
	(4)	0.000	(4)	0.014	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP EB	1-1	0	1-1	0	1-1	0
94	1-2	1	1-2	2	1-2	0
	1-3	1	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	45	2-2	45	2-2	0
	2-3	41	2-3	37	2-3	0
	2-4	0	2-4	1	2-4	0
	3-3	4	3-3	7	3-3	0
	3-4	0	3-4	0	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		92		92		0
NUMBER UNSCORABLE		2		2		0
ALLELE FREQUENCY	(1)	0.011	(1)	0.011	(1)	0.000
	(2)	0.717	(2)	0.707	(2)	0.000
	(3)	0.272	(3)	0.277	(3)	0.000
	(4)	0.000	(4)	0.005	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP F	1-1	0	1-1	0	1-1	0
200	1-2	1	1-2	0	1-2	0
	1-3	0	1-3	0	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	91	2-2	93	2-2	0
	2-3	96	2-3	90	2-3	0
	2-4	0	2-4	0	2-4	0
	3-3	12	3-3	16	3-3	0
	3-4	0	3-4	1	3-4	0
	4-4	0	4-4	0	4-4	0

TOTAL FISH SCORED	TFN		EST		PGI	
		200		200		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.002	(1)	0.000	(1)	0.000
	(2)	0.697	(2)	0.690	(2)	0.000
	(3)	0.300	(3)	0.308	(3)	0.000
	(4)	0.000	(4)	0.002	(4)	0.000

SAMPLE	TFN-SCORE		EST-SCORE		PGI-SCORE	
ZP G	1-1	0	1-1	0	1-1	0
200	1-2	3	1-2	0	1-2	0
	1-3	2	1-3	2	1-3	0
	1-4	0	1-4	0	1-4	0
	2-2	97	2-2	92	2-2	0
	2-3	82	2-3	78	2-3	0
	2-4	0	2-4	2	2-4	0
	3-3	17	3-3	25	3-3	0
	3-4	0	3-4	2	3-4	0
	4-4	0	4-4	0	4-4	0

		TFN		EST		PGI
TOTAL FISH SCORED		201		201		0
NUMBER UNSCORABLE		0		0		0
ALLELE FREQUENCY	(1)	0.012	(1)	0.005	(1)	0.000
	(2)	0.694	(2)	0.657	(2)	0.000
	(3)	0.294	(3)	0.328	(3)	0.000
	(4)	0.000	(4)	0.010	(4)	0.000