

**JIMAR, PFRP ANNUAL PROGRESS REPORT
FY 2001**

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Project Proposal Title: Genetic Analysis of Population Structure in Pacific Swordfish (*Xiphias gladius*) using Microsatellite DNA Techniques

Funding Agency: NOAA, NMFS, JIMAR

The last year has been spent working on three swordfish papers and two other papers, one on porcelain crabs and the other on scombroid systematics. These last two papers were submitted and published in 2001. Our first swordfish paper in Marine Biology described data from our mitochondrial DNA project and was published during the latter part of 2000. One of the three remaining swordfish manuscripts is a collaboration with Dr. Robert Ward at CSIRO in Hobart, Australia. This was a report to the Australian Fisheries Management Authority and entitled, "Population Structure of Australian Swordfish, *Xiphias gladius*". The report describes our work using both mtDNA and microsatellites for three populations of swordfish, two from either side of Australia and one from Reunion Island in the Indian Ocean. The results of the study are to be incorporated into a broader paper comparing Australian swordfish to our global data set. We are currently working on this paper with Dr. Ward. The two papers described below are of relevance to the JIMAR project.

The second swordfish manuscript describing our global study of swordfish (sample size = 478) is nearly finished. This manuscript has benefited greatly by the above collaboration in Australia. Previously, our Australian sample size was very small and so we were forced to combine both western and eastern samples together. This strategy was criticized in our Marine Biology paper. However, statistically there was no reason to believe that eastern and western fish were different. With the Australian study we were able to increase sample sizes to 260 individuals and it became clear that with mtDNA there was no obvious divergence between western and eastern Australian samples making the decision to group these samples in our Marine Biology paper valid. The Australian study further supported our early observation of a U-shaped corridor in the Pacific with mtDNA. However, the microsatellite data showed these populations to be slightly differentiated.

Although JIMAR may view the sequence of manuscript preparation unordered, the fact that this Australian study filled a critical gap in our view of swordfish genetics makes it beneficial that we examined the Australian data closely first. We discovered that swordfish collected off western Australia (Indian Ocean) is genetically more similar to our collections from the southeastern Pacific population (Chile and Ecuador) than the eastern Australian population is (Pacific Ocean). This underscores the complexity of swordfish migrations and highlights the challenge of correctly tying together population structure in a highly migratory species from samples collected opportunistically from

vagile adult fish. This project has been extremely difficult yet our lab stands alone in making sense of a bizarre, yet interesting puzzle.

A third paper will contain a review of our swordfish data related to population/stock structure. This paper will essentially be a combination of our mtDNA and microsatellite papers. With the help of Josh Eagle at the Stanford School of Law, this paper will include a section on policy issues surrounding a highly migratory species. Because so much genetic information now exists which shows evidence of population structure in swordfish (compared to other pelagic scombroids where genetic studies often fail to find differences except at basin level scales), an extensive review of the swordfish data will be used as a model for highly migratory species. An overlay of genetic patterns in swordfish with an outline of management jurisdictions will show that biological patterns and management regions often do not correspond. We will bring to light the fact that management must be based on international cooperation because stock boundaries do exist but these boundaries are often subtle and stocks can often overlap in areas that are likely feeding zones or corridors of migration. Hence the use of certain geographic areas must be understood from the point of view of the swordfish before effective management can begin.

These last two papers, one on global microsatellite data in swordfish and combining genetics and management policy, are of relevance to JIMAR's funding of our laboratory after which point the project will then terminate.

4. List of papers published in refereed journals during FY 2001.

None.

5. Other papers, technical reports, meeting presentations, etc.

Ward, R.D., C.A. Reeb and B.A. Block, 2001. Population structure of Australian swordfishes (*Xiphias gladius*). Final Report to Australian Fisheries Management Authority, Canberra.

6. Names of students graduating with MS or Ph.D. degrees during FY 2001. Include title of thesis or dissertation.

None.