

JIMAR ANNUAL REPORT FOR FY 2000

P. I. NAME: Richard W. Brill

PROJECT PROPOSAL TITLE: Laboratory and field research to enhance understanding of tuna movements and distribution, and to improve stock assessment models.

FUNDING AGENCY: NOAA, through the Pelagics Fisheries Research Program

1. Purpose of the project:

Population assessments based on catch-per-unit-effort (CPUE) data often assume “catchability” of a target species is constant; a tenuous assumption for tunas and billfishes which are both highly mobile and highly aggregated. Accurate population assessments, therefore, depend on the ability to differentiate changes in abundance due to over-fishing, from changes in specific gear vulnerability due to changes in oceanographic conditions. Before comprehensive models describing the movements and stock dynamics of tunas can be developed, and CPUE data translated into accurate population assessments, it is first necessary to understand how the vertical movements and depth distributions of tunas (i.e., their specific gear vulnerability) are effected by oceanographic conditions. It is the overall objective of this project to use laboratory and field studies (using ultrasonic telemetry and new archival data recording tags) to establish direct links between environmental conditions, fish movements, distribution, and gear vulnerability, and thus provide a means of improving current tuna stock assessments.

2. Progress during FY 2000:

Activities during this fiscal year were concentrated in several areas, all but one which were a continuation of previous projects. The new study, conducted with Dr. Keith Korsmeyer of Hawaii Pacific University, was designed to elucidate the physiological mechanisms and quantify the thermoregulatory abilities of yellowfin tuna. Continuing projects included the following: use of pop-up satellite archival tags (PSATs) to determine migratory movements and spawning areas of Atlantic bluefin tuna; use of archival tags to determine the movements and habitat utilization of bigeye tuna around the Hawaiian Islands; and investigation of metabolic biochemistry of the cardiac muscle in skipjack, yellowfin and bigeye tunas. The objective of the last study is to provide an understanding of the biochemical/physiological mechanism underlying the different depth distributions of these three economically important tuna species.

3. Plans for the next Fiscal Year:

Efforts during the FY2001 efforts will center on implantation of the remaining 15 or so archival tags into bigeye tuna around the main Hawaiian Islands and completing several manuscripts, including the one describing results from the study of tuna cardiac muscle biochemistry. Additional funding has been obtained by Edgerton Research Laboratory (New England Aquarium) for continuation of the project putting PSATs on Atlantic bluefin tuna. Because this project has identified a possible new spawning area in the central Atlantic, a research cruise to

look for spawning fish and larval bluefin tuna is currently being organized.

4. List of Papers Published in Referred Journals during FY 2000:

Lowe, T., R. Brill, and K. Cousins. Blood O₂-binding characteristics of bigeye tuna (*Thunnus obesus*), a high-energy-demand teleost that is tolerant of low ambient O₂. Mar. Biol. (In press).

Lutcavage, M.E., R.W. Brill, J.L. Goldstein, G.B. Skomal, B.C. Chase, and J. Tutein, Movements and behavior of adult northern bluefin tuna (*Thunnus thynnus*) in the northwest Atlantic determined using ultrasonic telemetry. Mar. Biol. (in press).

Brill, R., and M. Lutcavage. Research to understand environmental influences on the horizontal and vertical movements of tunas and billfishes, and improve stock assessments. Proceedings of a symposium on the Charleston Bump. Trans. Am. Fish Soc. (In press).

Brill, R. W. and P. G. Bushnell. Cardiovascular System of Tunas. Fish Physiology, Vol. 19; B. A. Block and E. D. Stevens (editors), Academic Press (accepted for publication).

Brill, R., Y. Swimmer, K. Cousins, C. Taxboel, and T. Lowe. Na⁺-K⁺ ATPase activity and estimated osmoregulatory costs in three high-energy-demand teleosts: yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), and dolphin fish (*Coryphaena hippurus*). Mar. Biol. (submitted).

Brill, R., M. Lutcavage, G. Metzger, P. Bushnell, M. Arndt, J. Lucy, and C. Watson. Horizontal and vertical movements of juvenile Atlantic bluefin tuna (*Thunnus thynnus*) determined using ultrasonic telemetry, with reference to population assessment using aerial surveys. Fish. Bull. (submitted).

Musyl, M. K., Brill, R. W., Curran, D. S., Gunn, J. S., Hartog, J. R., Hill, R. D., Welch, D. W., Eveson, J. P., Boggs, C. H., and Brainard, R. E. Ability of archival tags to provide estimates of geographical position based on light intensity. Proceedings of the Symposium on Tagging and Tracking of Marine Fish with Electronic Devices. (submitted).

5. Other Papers, Technical Reports, etc.

Lutcavage, M., R. Brill, G. Skomal, B. Chase, Paul Howey, and J. Porter. 1999. Tracking giant bluefin tuna: Integration of meso and macroscale tagging technologies. [Abstract] Proceedings of the Third Conference on Fish Telemetry in Europe.

Brill, R., M. Lutcavage, G. Metzger, P. Bushnell, M. Arendt, and J. Lucy. 2000. Short-term (48-hour) survival rates of juvenile bluefin tuna (*Thunnus thynnus*) following catch and release, determined using ultrasonic telemetry. [Extended abstract] Proceedings of the National Symposium on Catch and Release in Marine Recreational Fisheries.

Brill, R., C. Boggs, and M. Musyl. 2000. Horizontal and vertical movements of bigeye tuna (*Thunnus obesus*) carrying archival tags. [Abstract] Symposium on Tagging and Tracking Marine Fish With Electronic Devices.

Musyl, M.K., R.W. Brill, C. H. Boggs, and R.E. Brainard. 2000. Ability of electronic archival tags, submerged at varying depths on a stationary mooring line in the Pacific Ocean, to provide estimates of geographical position based on light intensity: How good are they? [Abstract] Symposium on Tagging and Tracking Marine Fish With Electronic Devices.

Brill, R., C. Boggs, T. Kazama, M. Musyl, and D. Curran. 2000. Horizontal and vertical movements of bigeye tuna (*Thunnus obesus*) carrying archival tags. [Abstract] Proceedings of the 51st Annual Tuna Conference.

6. Names of Students Graduating with MS or Ph.D. Degrees during FY 2000; Titles of their Thesis or Dissertations.

None