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**HAWAII TUNA TAGGING PROJECT II: PROJECT DESCRIPTION**

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### **Abstract**

Skipjack, yellowfin and bigeye tuna are harvested by a variety of gear types and fisheries in Hawaii from small recreational/subsistence trollers and commercial handliners to large, modern longline vessels. The smaller scale tuna fisheries rely heavily on exploiting schools found in association with bathymetric features (seamounts, ridges and banks), drifting debris or fish aggregation devices whereas the longline fishing grounds change seasonally. Hawaiian tuna fisheries are also highly dynamic, shifting fishing areas and methods in a highly competitive manner. During the 1980s, a new fishery developed to exploit juvenile/sub-adult bigeye and yellowfin found in association with a productive offshore seamount and offshore weather buoys that act like FADs. High catch rates at the seamount prompted local concern that the seamount fishery might negatively impact adjacent fisheries and fishing grounds by intercepting fish that would normally supply these other fisheries (primarily inshore handline and offshore longline fleets). In response to these concerns, the Pelagic Fisheries Research Program funded the Hawaii Tuna Tagging Project (HTTP) that deployed over 15,000 conventional tags on bigeye and yellowfin tuna (1995-2000) to address issues of interaction and movement between geographical areas and different fishery sectors. The project was very effective, quantifying residence times of bigeye and yellowfin tuna on the seamount, exchange rates between major fishing grounds or fisheries and providing size-dependent estimates of natural and fishing mortality. Since the end of the HTTP, the seamount fishery has evolved in new directions while privately set “bigeye FADs” have proliferated closer to shore. These and other developments in the domestic and expanding international fisheries have created a new set of user group conflicts and management concerns. The PFRP is currently funding the HTTP II. The new program will update movement parameters and estimates of F and M derived by the previous program while adding skipjack to the species to be studied. The project will utilize a variety of conventional and electronic tag types and concentrate on tagging in areas or fisheries that were not examined or well developed during the original HTTP. The HTTP II will commence in the third quarter of 2008 and will be considered as an independently funded, sub-regional component of the broader SPC/WCPFC sponsored Pacific Tuna Tagging Programme, using common methodologies with arrangements for integrated data sharing and analysis.

### **Background**

The Pelagic Fisheries Research Program has funded a number of tagging initiatives to provide information useful for the management of pelagic resources in the central and western Pacific region. These tagging projects have used a variety of tag types and methods to examine local and medium-scale fishery issues. For example, recent PFRP funded initiatives have used sonic and archival tags to examine issues of residence time, school fidelity and movements of yellowfin

(*Thunnus albacares*) and bigeye tuna (*T. obesus*) within a network of anchored FADs (Dagorn et al. 2006; Itano et al. 2006). The PFRP has also funded experiments investigating general aspects of tuna behavior and physiology that have application not only in Hawaii but in the broader WCPO and worldwide. These include the development of tags for detecting feeding behavior in large predators (Papastamatiou, 2007) and the use of depth sensitive sonic tags to examine size-related and species specific differences in vertical behavior of tropical tuna associated with FADs. These experiments were conducted in Hawaii and Papua New Guinea and the results may be of relevance to purse seine selectivity (Holland et al. 2006; Leroy et al. 2007).

These behavioral studies were designed upon and built on the foundation laid by the Hawaii Tuna Tagging Project (HHTTP) which used conventional tags to address interaction and movement issues relevant to Hawaii-based commercial and recreational fisheries. However, it has been eight years since the HHTTP has concluded during which time local fisheries have changed and evolved. In order to update movement and life history parameters of tuna relevant to Hawaii and the broader WCPO and to address current fishery issues, the HHTTP project is being revisited. Commencing in 2008, the PFRP initiated funding of the second HHTTP, or Hawaii Tuna Tagging Project II (HHTTP II), which is briefly described in this document. It is envisioned that this project will be the first independently funded domestic tagging effort coordinated as a sub-regional component of the broader Pacific Tuna Tagging Project (PTTP) being implemented by the SPC Oceanic Fisheries Programme ( see WCPFC/RTPSC 2007 for a full description of the PTTP).

### **HHTTP description**

The HHTTP commenced in 1995, and had released over 15,000 dart-tagged yellowfin and bigeye tuna in roughly equal numbers by 2000 with a return rate of 10.3% (Itano and Holland 2000). The analyses of recapture data from the HHTTP proved very useful, defining species-specific residence times and exchange rates of yellowfin and bigeye tuna in the Hawaii EEZ and between major fisheries or fishing areas (Adam et al. 2003; Sibert et al. 2000).

The HHTTP was the first significant tuna tagging effort for Hawaii and in the central Pacific. As such, it was carefully planned by consensus through input from the Western Pacific Regional Fishery Management Council (WPRFMC) and its subsidiary bodies, a specific planning workshop (Hawaii Tuna Tagging Workshop coordinated by PFRP) and a specific design study (Bills and Sibert 1997). The project planning team and planning workshop was composed of tuna tagging and fishery experts from the PFRP, NMFS, Hawaii Division of Aquatic Resources (HDAR), Inter-American Tropical Tuna Commission (IATTC), <then> South Pacific Commission (SPC) and the local fishing industry.

The consensus of these groups in the planning of the HHTTP was:

- That the large-scale tagging projects of the SPC were designed for and more relevant to the large volume fisheries of the western equatorial Pacific but was not particularly useful to address smaller-scale issues in Hawaii.
- That the mounting of a large-scale tuna tagging project for the central and north Pacific

was beyond the scale of available funding of the PFRP.

- That a medium-scale tagging project for the Hawaii EEZ would be more appropriate and feasible while still providing needed estimates of attrition, growth, movement and interaction within the Hawaii EEZ.
- That such a study would be well supported by two (then) currently funded PFRP projects: (I) Design of tag-recapture experiments for estimating yellowfin tuna stock dynamics, movement and fishery interactions, and; (ii) A tag and release program for the Hawaiian seamount yellowfin and bigeye tuna handline and troll fisheries.
- That the tag release effort not be limited to a single year in order to at least minimally address questions of inter-annual variations as related to large-scale environmental factors in the marine environment.
- That a variety of tagging methodologies be combined, including archival tagging to yield as much information as possible given currently available technology.
- That an EEZ wide tagging project emphasize tag releases of bigeye tuna over yellowfin and divert little effort toward skipjack tagging.

At the time of planning the HTTP, a relatively new fishery had developed and was still expanding that targeted juvenile bigeye and yellowfin tuna on a productive offshore seamount and offshore weather buoys that acted like productive anchored FADs. Catch rates achieved by this fishery were relatively high, especially for bigeye tuna, and there was local concern on its impact on recruitment to other fisheries (primarily offshore longline and inshore handline/troll). As such, the primary objectives of the HTTP were to examine:

- Movement of bigeye and yellowfin within the Hawaii EEZ and between major fishing grounds.
- Interaction
  - direct gear interaction / concurrent interaction between competing fisheries in the same time/area strata for the same sized fish, including surface and sub-surface gear types
  - sequential or progressive interactions as fish grow, exit and enter different fisheries
  - spatially segregated interaction where fish move between fishing grounds and enter new fisheries remote in time and space
- Exploitation rates and differential vulnerability (local fishing mortality) of tuna around seamounts and Fish Aggregation Devices (FADs)

- Aggregation effects - retention rates of bigeye and yellowfin tuna around seamounts, FADs and local fishing grounds.

The HTTP was highly successful in meeting these objectives for yellowfin and bigeye tuna taken in the offshore study areas. Analysis of the recapture data resulted in estimates of seamount residence time for bigeye and yellowfin tuna, size-specific estimates of fishing and natural mortality and useful transfer rates of tuna from the seamount and offshore FADs to other areas and fisheries. However, the HTTP did not release proportionally significant numbers of conventional tags from inshore fishing grounds and nearshore FADs which did not allow the calculation of two-way exchange rates or movement and residence parameters for inshore fishing grounds.

## **HTTP II justification and Project description**

As previously stated, it has been eight years since the end of the tag release phase of the HTTP. During this time, Hawaii-based pelagic fisheries have continued to evolve while the resource condition of tropical tunas has declined throughout the Pacific. The HTTP was designed and implemented primarily to address local-scale interaction issues for bigeye and yellowfin tuna that centered on the surface fisheries of the Cross Seamount located approximately 150 nautical miles offshore. In the intervening years, several changes have occurred in Hawaii-based tuna fisheries. These include:

- A decline in effort in the surface fisheries for juvenile bigeye and yellowfin on the Cross Seamount and offshore weather buoys;
- An increase in the setting and exploitation of privately set FADs close to the main Hawaiian islands, primarily aggregating and harvesting sub-adult bigeye tuna;
- Increased harvesting of very small yellowfin tuna from the inshore Hawaii State FADs;
- The development and expansion of a deep-set short longline fishery on the Cross Seamount to target larger bigeye tuna and seamount associated pomphrets;
- A general increase in tuna longline by the domestic fishery due to conversion of some swordfish effort and a steadily increasing number of hooks per tuna set.
- A perceived low local abundance of skipjack and the steady decline of the domestic pole and line fishery.

In the meantime, distant water longline and purse seine fisheries south and west of Hawaii have continued to expand in capacity, effort and catch. WCPO landings in excess of two million mt/year of albacore and tropical tuna species continue while the relationship (connectivity) of tropical tuna between Hawaii and the broader WCPO remains poorly understood.

The HTTP is being planned and implemented to update mortality and movement parameters derived from the HTTP and to address new issues of management concern, while adding skipjack to the species to be investigated. The three principal objectives of the HTTP II are:

- 1) to update estimates of fishing mortality (F), ‘natural’ mortality (M) and movement parameters for yellowfin and bigeye tuna in Hawaiian waters while deriving initial estimates of F, M and movement parameters for skipjack.
  - a. To include a continuation of existing PFRP projects to define the typical size of habitat for “Hawaiian” tuna using sonic, archival and PAT tags,
  - b. ... with a greater emphasis on areas and species under-represented during HTTP, i.e.
    - i. bigeye tuna found around the main Hawaiian Islands and targeted by the private FAD fishery, and
    - ii. yellowfin and skipjack tuna on FADs and near shore aggregation sites,
  - c. ... with increased emphasis on tagging unassociated or near shore bank associated tuna schools with both conventional dart and acoustic tags. This segment is an attempt to estimate the amount of exchange (‘recruitment’) between free schools and FADs.
- 2) Document the FAD-associated temporal and vertical behavior of skipjack tuna.
  - a. Using acoustic pinger and depth reporting tags on receiver equipped FADs with
  - b. ... simultaneous releases with yellowfin and bigeye tuna to provide species-specific comparisons in mixed aggregations.
- 3) Determine the diurnal vertical behavior of bigeye tuna, yellowfin tuna and lustrous pomphret (*Eumegistis illustris*) associated with the Cross Seamount.
  - a. Using acoustic depth reporting tags on all three species in simultaneous seamount residence,
  - b. ... which will require deployment of acoustic receivers on bottom-mounted acoustic release systems.

### **Project outline**

- Species to tag
  - skipjack, yellowfin tuna, bigeye tuna, lustrous pomphret (*E. illustris*)
- Tag types
  - conventional plastic dart tags (Hallprint)
  - Vemco acoustic tags (V9, V9P, V13P, V16P)
  - Wildlife Computers MK9 archival tags
  - Wildlife Computers MK10 PAT tags
  - (possibly other archival and PAT types depending on future availability)

- Associated hardware
  - VEMCO VR2 and VR2W ultrasonic receivers
  - Acoustic release system (to be determined)
- Fish release size
  - Dart tags > 30 cm
  - Acoustic tags > 45 cm depending on species and tag type
  - Archival tags > 60 cm depending on species and tag type
  - Pop-up Archival Tags > ~120 cm
  - Mini-PAT or single point PAT tags (subject to availability)
- Release sites
  - Hawaii State FADs surrounding main islands
  - Private or “Community” FADs around main islands
  - Nearshore banks and tuna aggregation sites
  - Cross Seamount
  - Open water areas
- Release timetable
  - Two years commencing late 2008
- Tagging platforms
  - Hawaii-based pole-and-line vessel
  - Offshore handline and short longline vessels
  - Private FAD fishing and support vessels
  - Inshore *ika shibi* and *palu* ahi handline vessels
  - UH RV Opah using troll, handline and vertical longline
- Fishing gears and methods
  - Pole-and-line
  - Troll
  - Handline (day and night)
  - Short longline
  - Vertical longline
- Tagging gear and methods
  - Standardized methods for conventional and archival tagging of tunas used during the HTTP, PFRP funded archival and sonic tagging projects and SPC projects (Skipjack Survey and Assessment Programme, Regional Tuna Tagging Programme, Papua New Guinea TTP and Pacific Tuna Tagging Programme)
- Data recording and handling
  - Standardized data recording and backup procedures currently used by the PTTP
  - Data entry and preliminary reporting using PTTP tagging database TAGDAGER
- Publicity and tag rewards/distribution

- Conventional tag rewards – variety of T-shirts, hats and misc items bearing HTTP II logo
- Sonic and Archival rewards – cash awards, varies depending on tag type
- Key Personnel
  - Dr Kim Holland, Professor, Hawaii Institute of Marine Biology, University of Hawaii
  - Dr Kevin Weng, University of Hawaii, SOEST Young Investigator/Assistant Researcher
  - David Itano, Research Associate, Pelagic Fisheries Research Program, University of Hawaii
- Data processing and analysis
  - Local analysis of data that addresses domestic or local-scale concerns
  - Combine data with PTPP for large-scale analysis by SPC

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