



Title of Investigation:

The Great Pacific Turtle Race

Principal Investigator:

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Other In-house Members of Team:

Mr. Brian Campbell (Code 614) and Dr. Tiffany Moisan (Code 614.2)

Other External Collaborators:

Dr. Jeffrey Polovina (NOAA) and Dr. Peter Dutton (NOAA)

Initiation Year:

FY 2004

Aggregate Amount of Funding Authorized in FY 2004 and Earlier Years:

\$15,000

Funding Authorized for FY 2005:

\$25,000

Actual or Expected Expenditure of FY 2005 Funding:

In-house: \$10,000; Contracts: \$15,000, SGT, Inc.

Status of Investigation at End of FY 2005:

DDF support will end in FY 2005. The project can be reinitiated each year, but no prize funds will be available. In addition, the satellite co-location effort will be maintained as part of our continued efforts at the Goddard Space Flight Center to supply users with satellite data. We will investigate if NASA Headquarters can support this effort further.

Expected Completion Date:

October 2006 (DDF-supported R&D)

DDF annual report

Purpose of Investigation:

The purpose of this investigation is to create a global educational activity—in this case, a “Sea Turtle Race”—that would allow students worldwide to participate by way of the NASA portal. From this site, students could use satellite data to derive sea-surface temperature and chlorophyll data so that they could estimate available turtle food and simulate the path that the turtles would take as they forage and migrate westward across the Pacific from feeding grounds near Baja California.

Our primary focus is to educate those in grades K-12 about the environmental variables that loggerhead turtles endure during their long potentially dangerous race. By attracting a global audience, we hope to forge funding partnerships with other agencies, universities, museums, and/or private businesses. We will follow the Professional Development, Teaching, and Program Standards, as outlined in the National Science Education and National Geography Standards.

Loggerhead turtles (*Caretta caretta*) demonstrate an extreme in ocean migratory behavior. In the Pacific Ocean, this species of ocean-going turtle has major nesting areas in Japan and Australia. Juveniles are often captured and released from deep-water fishing lines as they forage and migrate westward across the Pacific from feeding grounds near Baja California. Adult turtles have previously been tracked migrating westward across the Pacific Ocean through the slow, eastward-flowing current region of the North Pacific Transition Zone Chlorophyll Front (TZCF).

Researchers have proposed that these turtles, both juvenile and adult, migrate through this region to forage within the oceanic frontal features that compose the TZCF. This hypothesis is based upon previous turtle-tracking efforts that focused on observations from juveniles collected from long-line fishing vessels. Several other hypotheses have been put forth explaining why these turtles swim against the mean current, thrive within an “ocean desert,” and transit across a large span of open ocean—behavior that allows them to nest along one coast, while foraging along another. Previous scientific studies relied on low-resolution Global Area Coverage (GAC) data for sea-surface temperature and surface chlorophyll a. The conclusions from these studies demonstrate that much remains to be learned about the behavior of these animals.

Accomplishments to Date:

We initially proposed to collaborate with NOAA turtle biologists and several public aquariums to use satellite-tracking capabilities and the higher-resolution Local Area Coverage (LAC) data sets available from the Aqua and Terra satellites. The satellite data sets would be processed and specific observations would be made concerning the area where the tagged turtles were located. The problem that we initially faced was that the FY 2004 funds were cut from our requested amount of \$55,000 to \$15,000, leaving us with little to no funds to purchase satellite-tracking tags for the turtles. Our intent was then to focus on developing a tracking capability that would allow the turtle scientists to collocate historical satellite data sets onto their archived historical turtle-tracking data sets. That way, they could reapply for additional funds in the second year to actually tag and track turtles. To accomplish this, we developed a Web-based capability that we called “geotrack.” (See Figure 1 for a more detailed look at the Web site’s format.) Under this system, the user essentially uploads a formatted “Date, Time, Latitude, Longitude” data set, chooses the types of satellite data he or she wishes to acquire, and submits the processing job through the

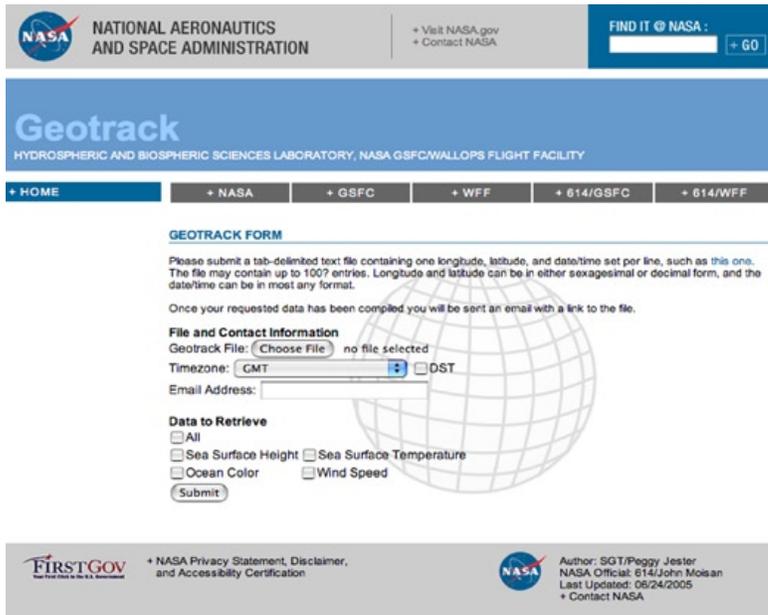


Figure 1. Web page [<http://science.wff.nasa.gov/geotrack/geotrack.php>] developed to allow users to collocate satellite data sets onto their organism tracking data sets. The initial focus was to allow tracking of marine organisms such as whales, turtles, dolphins, etc. We are now planning to include terrestrial data sets (NDVI) and, thereby, allow for a fully global remote sensing support capability.

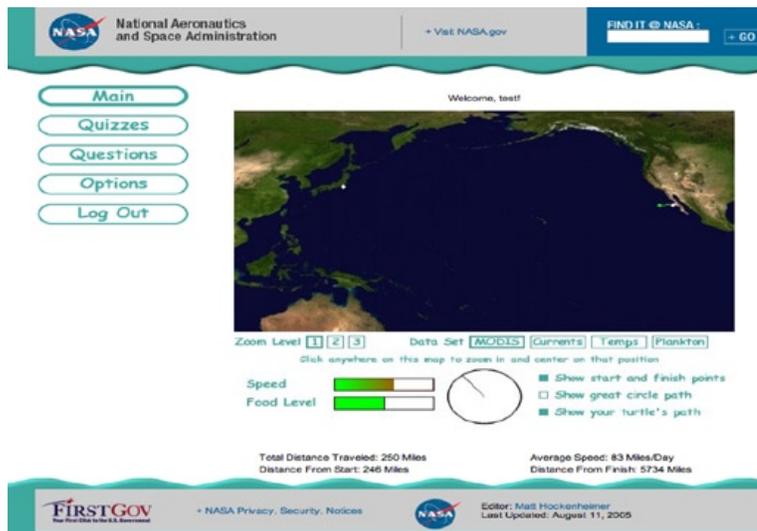


Figure 2. Screen capture of the initial turtle race control screen. Individual teachers will sign up their students to participate in the virtual race over the course of a school year. The students are required to update daily their chosen direction and speed (whose maximum value is tied to available food, temperature, etc.) <http://oosa.wff.nasa.gov/GPTR/test/main.php>



Figure 3. Screen dump of google-earth page. We will interface the map capabilities of the google-earth software with the turtle race simulator. Google-Earth software allows satellite data sets and tracks to be easily overlaid onto the mapping regions and navigation tools allow the user easy access to zooming, rotation and other features.

Web link. The appended time series then would be sent electronically to the chosen site. Currently, we are working to update this effort by including terrestrial data sets, such as NASA's Normalized Difference Vegetation Index (NDVI) data.

In the second year of the effort, while waiting to obtain a review of the DDF proposal, we realized that we could drastically reduce our program costs by forgoing the turtle tagging and developing a simulated turtle race instead. We worked hard last summer carrying out this work and putting together a preliminary Web site from which to host the actual turtle race. Figure 2 shows a screen capture of the Web page, which allows individual students to control their turtle's swim direction and path. In the past month, we have decided to improve this entire project by bringing in the novel mapping capability presented by Google-Earth (Figure 3). Our program goals remain the same— to host a race of turtles across the Pacific Ocean. Under the new scenario, students will be assigned a unique turtle and they will decide which direction their turtles take and how fast they travel. Travel speeds are dependent on ocean temperatures, food supplies, and ocean surface currents. The race will take place in a simulated mode, but continue to rely on daily maps of satellite sea-surface temperature, model-derived surface currents, and satellite-derived estimates of food concentrations.

Key Points Summary:

Project's innovative features: The innovative elements within this proposal are to use NASA satellite-derived data to support research efforts on marine turtles and to use a "Sea Turtle Race" to create an educational program for K-12 students. The program would demonstrate the various methods NASA uses to study the ocean.

Potential payoff to Goddard/NASA: The payoff for science is to develop a capability for linking satellite-derived science to satellite-tracked animal studies. This will link NASA scientists to a wide number of animal researchers looking for additional sources of environmental data sets.

The criteria for success: The criterion for success is that the unique aspect of carrying out a "Great Pacific Turtle Race" creates interest from the public. Currently, we have located the required data sets and are actively archiving them locally. We have developed and are testing the turtle race simulation software. Once testing is complete, we will combine everything into a Google-Earth application and test its capabilities. Our goal is to host our first annual race at the beginning of the next academic year (September 2006). We will consider our efforts successful if we complete the first annual turtle race, with one winner and no losses.

Technical risk factors: The technical risk factors that might prevent us from succeeding involve hardware and software failures.