


Animal Tracking Technology for Environmental Research

Jim Omura
Gordon and Betty Moore Foundation
October 16, 2008



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Foundation at a Glance

- **Founded in September 2000 (San Francisco, CA)***
- **Program Areas**
 - Environmental Conservation (50%)
 - Science (30%)
 - San Francisco Bay Area (20%)
- **Facts and Figures**
 - Endowment ~ \$6 billion
 - Gift 5% per year ~ \$300 million per year
 - Number of employees ~ 80
 - Number of grants awarded ~ 600
 - Total value of grants awarded ~ \$1.5 billion

*Moving to Palo Alto in January 2009

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Most Grants in Initiatives

**Long term programs with multiple grants where
the total is greater than sum of parts**

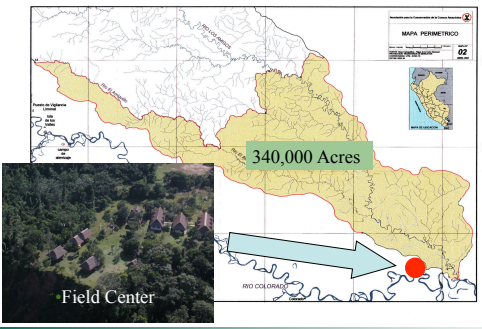
- **Andes Amazon**
- **Wild Pacific Salmon**
- **Marine Microbiology**
- **Marine Conservation**
- **Special Commitments**
 - CalTech
 - Conservation International
 - Nursing (limited to Bay Area)
 - Thirty Meter Telescope

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Networking A Remote Amazon Rain Forest Research Site

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Los Amigos Conservation Concession

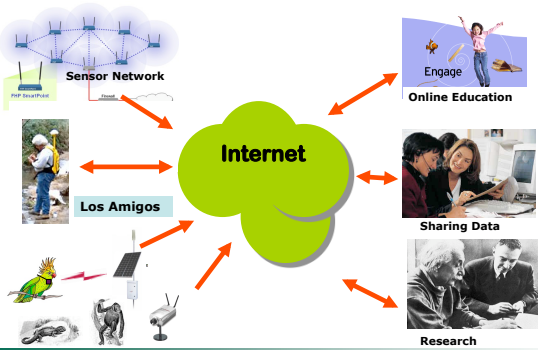


340,000 Acres

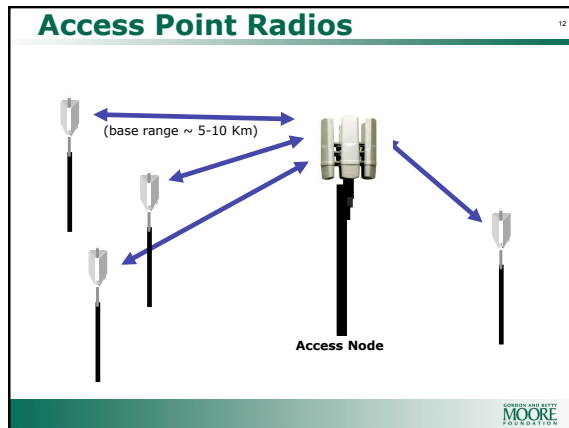
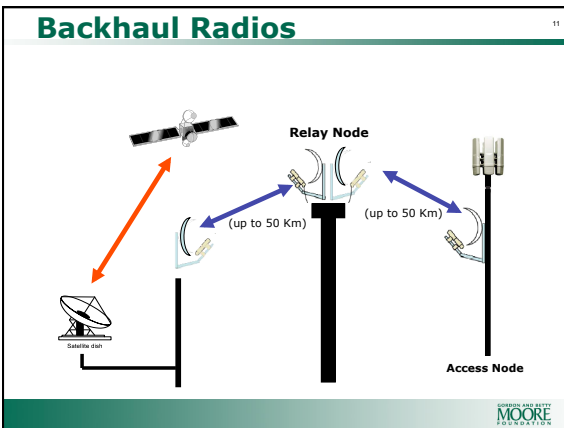
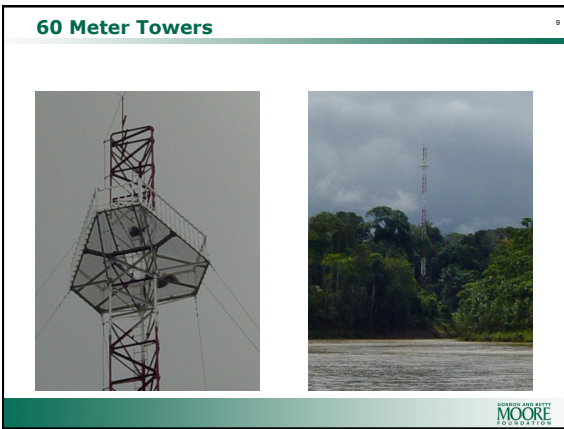
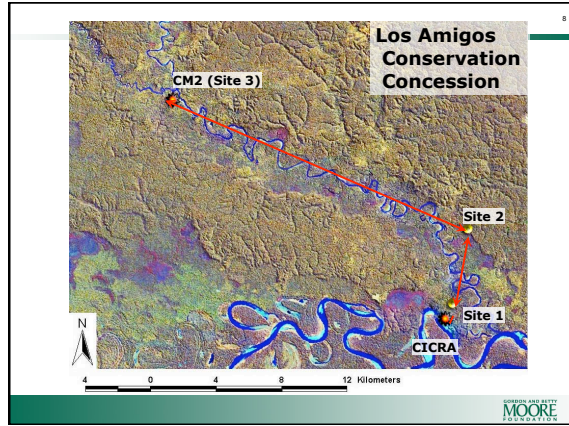
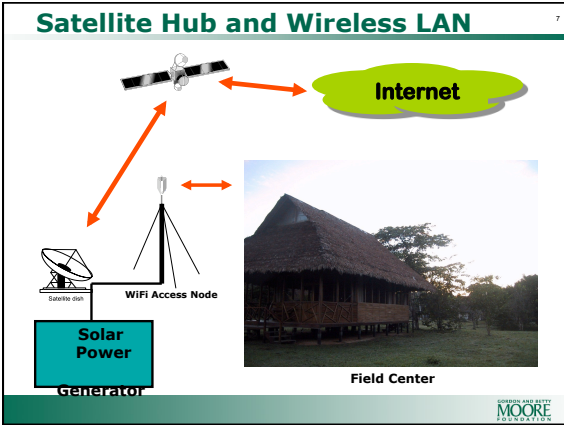
Field Center

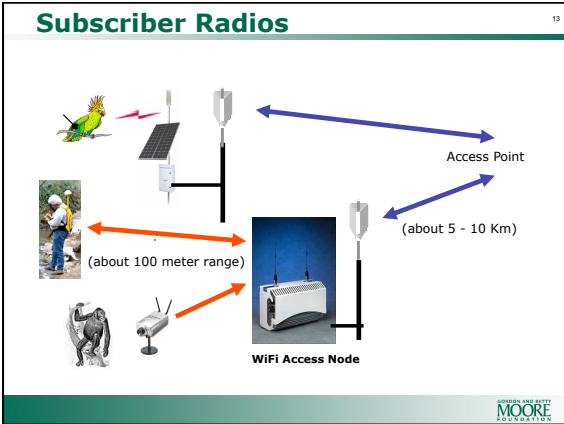
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Vision for Networking



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What is wrong with existing receivers?

- Labor intensive – leads to incomplete data & high costs
- Limitations on number of simultaneous tags
- Only real-time if people can be out gathering data all the time
- Short transmitter life
- Short range
- Require power-hungry tags

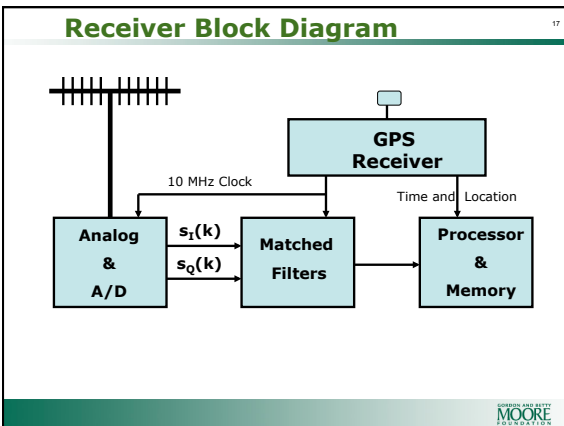
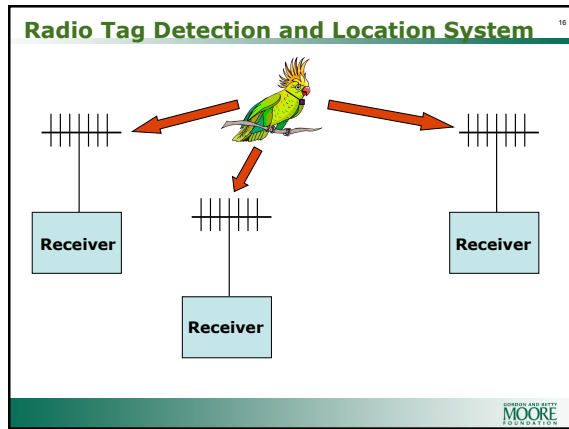
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Automatic Radio-location Project

What are we building?

- Allows researchers to monitor the position of animals in real time
- Completely automated
- Thousands of animals can be monitored simultaneously
- Uses much lower power tags and allows longer lifetimes for comparable weights

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BPSK prototype transmitter

- Presently radiating ~ 0 dbm
- 1 Mcps
- 1457 chip sequence (subset of 2048 Gold Code maximal length code)

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System performance – fixed point tests

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- Current range is 7 km
- Covering an area of 150 km² with 3 receivers
- Position resolution is about 50 m



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Testing in Netherlands

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Tracking Juvenile Salmon in British Columbia

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Tags for Marine Animals by Lotek

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- Tags with Sonar transmitters
- Smallest is 4.0 grams
- Sends signal to ID fish
- Up to 1 Km range
- Size and range ~ 1/f

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Steelhead Trout Pre-Smolt Sonar Tag

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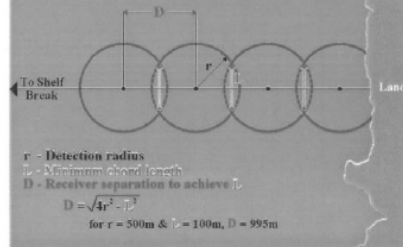


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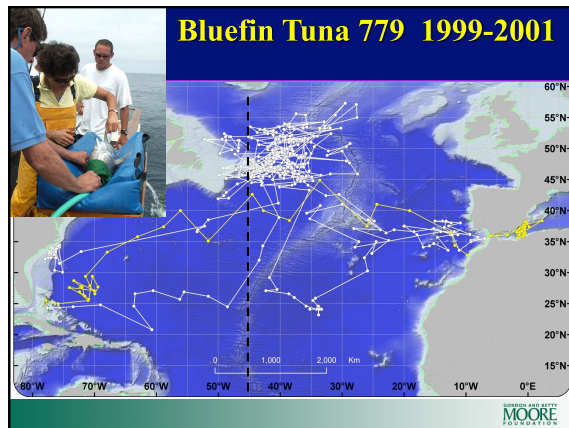
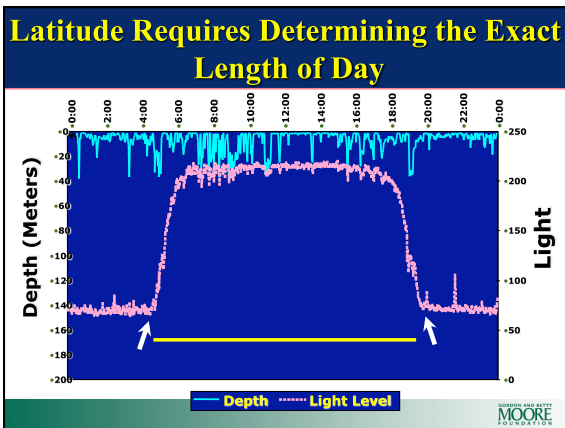
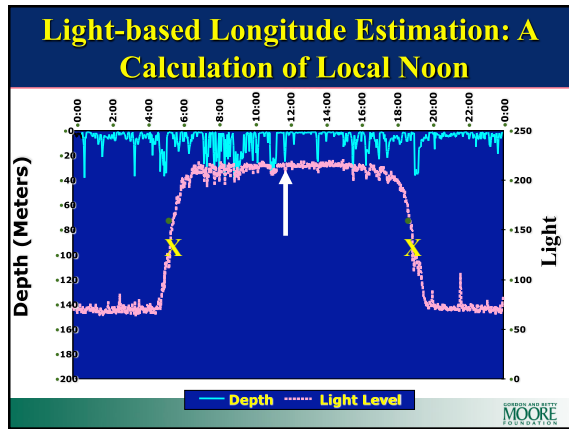
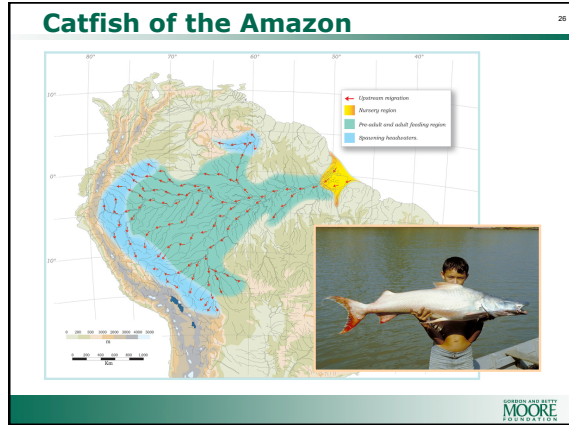
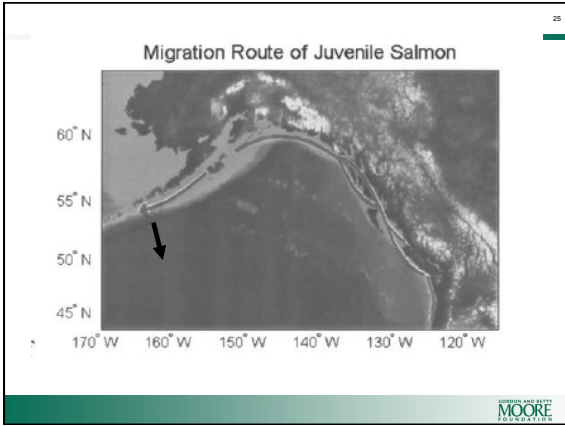
Array of Sonar Receivers Along Costal Shelf

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Pacific Ocean Salmon Tracking (POST)
Proposal by Kintama Research Corp.



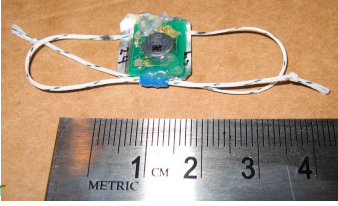
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Geolocation Logger

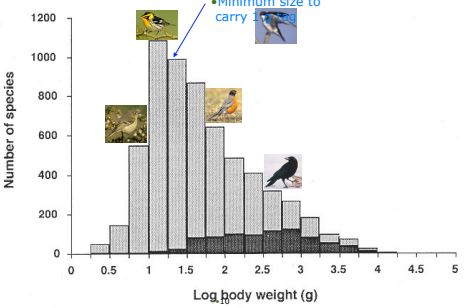
Present tag deployed weight is 0.9g
Includes light, pressure & temperature logging

- 8kB memory
- 6 mo lifetime (solar cell for much longer life)
- Being deployed on swallows
- Now improving design for better data acquisition and off-loading



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Despite constant pressure for reduction in mass, we have settled on trying to achieve a 1 g package.



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New Electronic Tags for Tracking Pelagics

- Archival Tags
- Satellite Tags
- Pop-Up Satellite Archival Tags
- GPS Tags
- GPS Archival Tags



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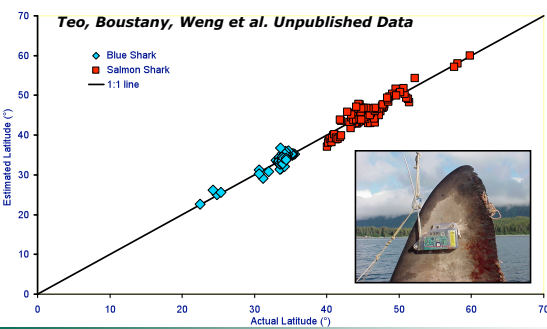
18 Foot Boat and 19 Foot Great White Shark



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Estimated vs Actual Latitude

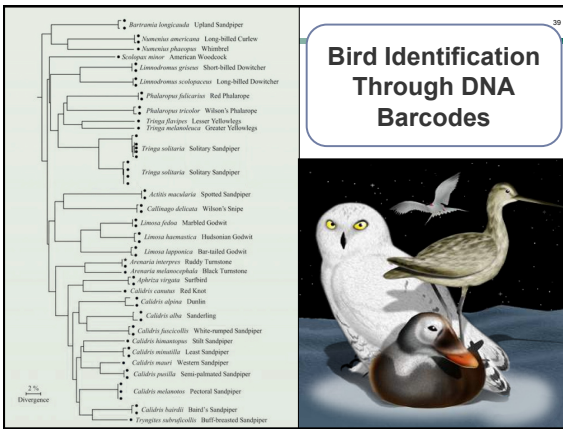
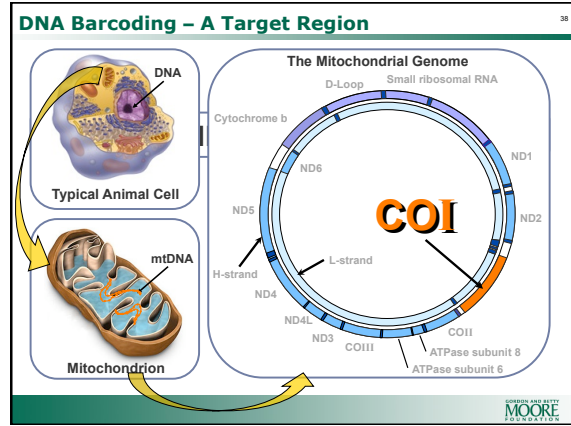
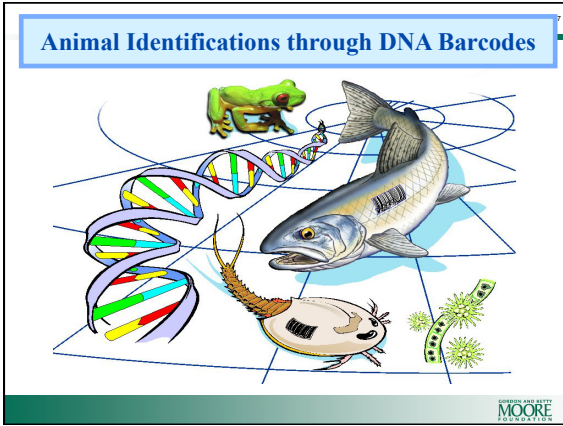
Teo, Boustany, Weng et al. Unpublished Data



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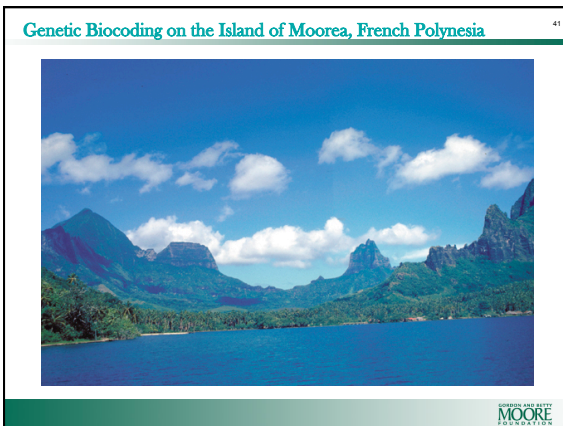
DNA Barcodes and SNPs

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- Invasive species check at ports and border crossings
- Sampling fish in supermarkets

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Single Nucleotide Polymorphism (SNPs)

Bear populations in the North Pacific

- Grizzly and black bear population study
- Dogs used to find scat left by bears
- SNPs analysis used to determine family of bears in area
- Determine species, gender, and individual identities

Collection of Salmon SNPs data for rivers in North Pacific

- UW school creating open-access databases
- Individual salmon can be identified with spawning river
- Samples from fishing fleets to local markets

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Thank You