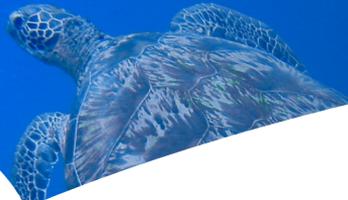


**NOAA  
FISHERIES**



# Defining Units to Conserve for Marine Turtles

Peter H. Dutton

Leader, Marine Turtle Genetics Program,  
Mammal & Turtle Research Division

NOAA Fisheries, Southwest Fisheries Science Center

Review of NOAA Fisheries' Science on Marine Mammals & Turtles  
Southwest and Northwest Fisheries Science Centers

27-31 July 2015

La Jolla, CA



**NOAA  
FISHERIES**

## *MTGP Mission :*



- Serve as the NOAA-Fisheries' National Sea Turtle Genetics Lab
  - responsible for generating, analyzing and interpreting genetic data to address the scientific and management needs for the agency.
- = Improve science of conservation**

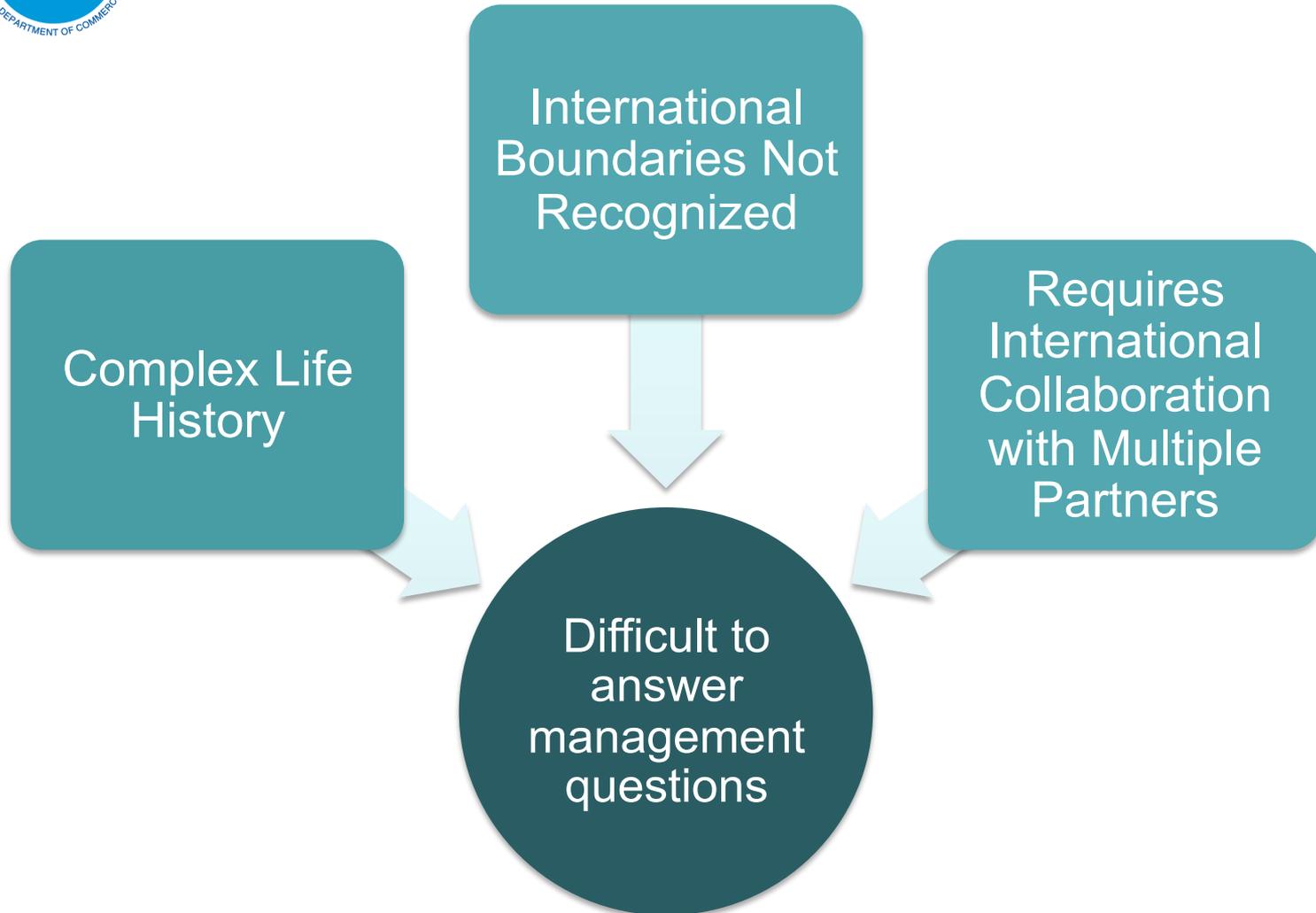
# Links with Mandates, Needs of Regulatory Partners

- Endangered Species Act
  - Recovery Plans (Status Reviews & Stock Assessments)
  - Section 7 consultations
- Magnuson-Stevens Act
  - Bycatch reduction
- International Agreements
  - Inter-American Convention for Sea Turtles (IAC)
  - Convention for Migratory Species (CMS)
  - Bilateral Agreements (Indonesia S&T; Chile; Mexico)

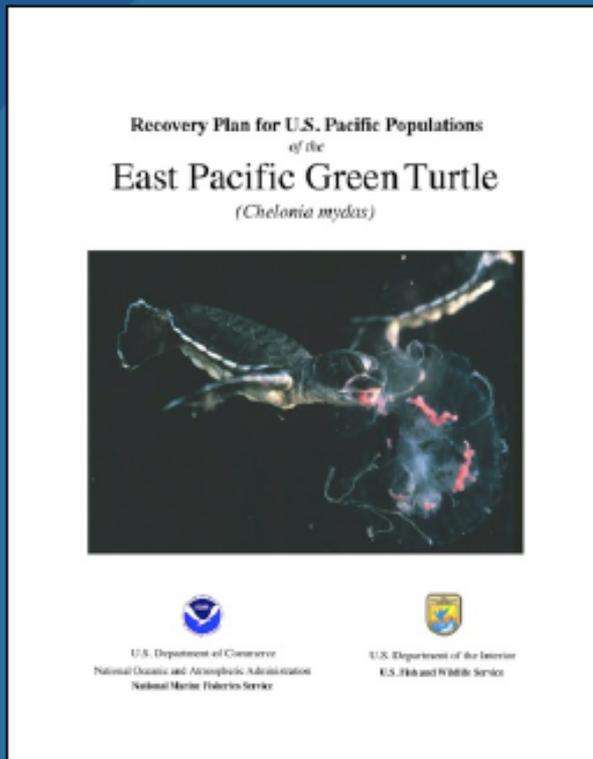




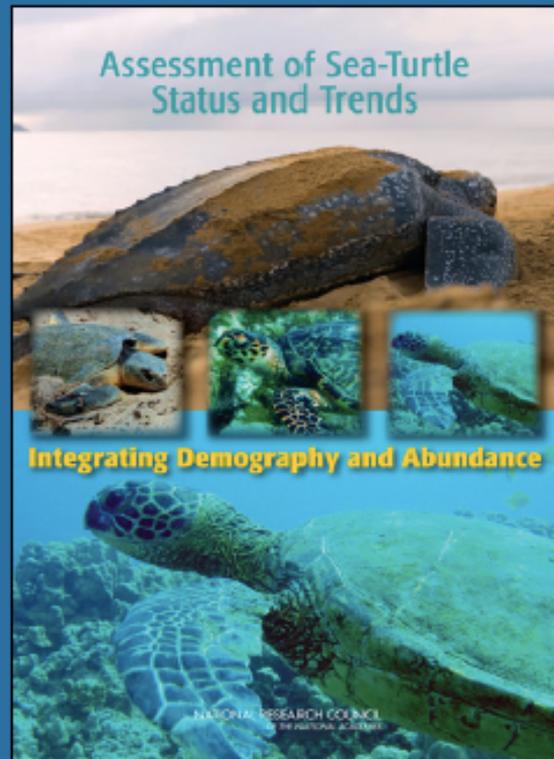
## Challenges



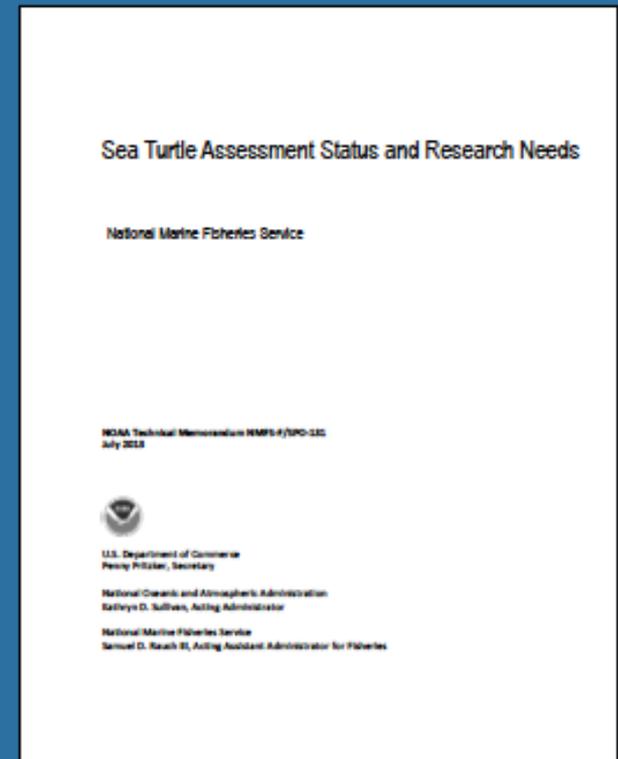
# Blueprints for research and assessment of U.S. Pacific sea turtle populations



Recovery Plans (1998)



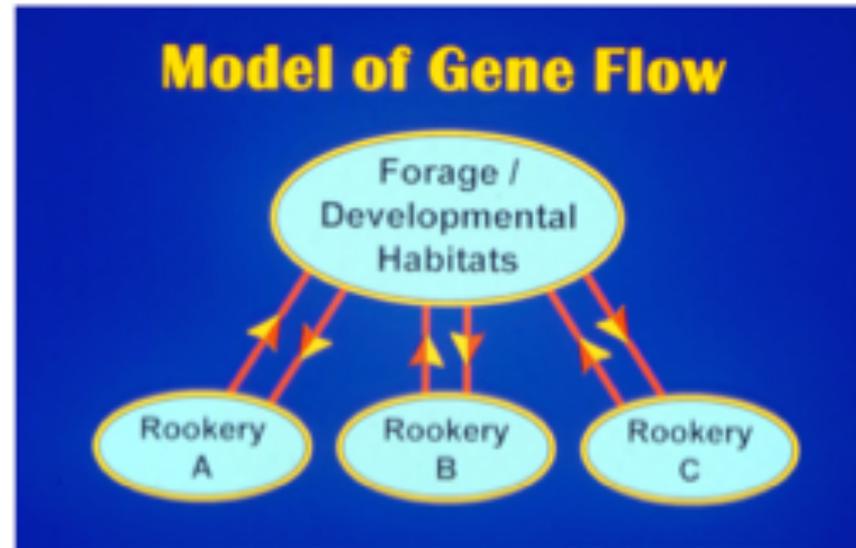
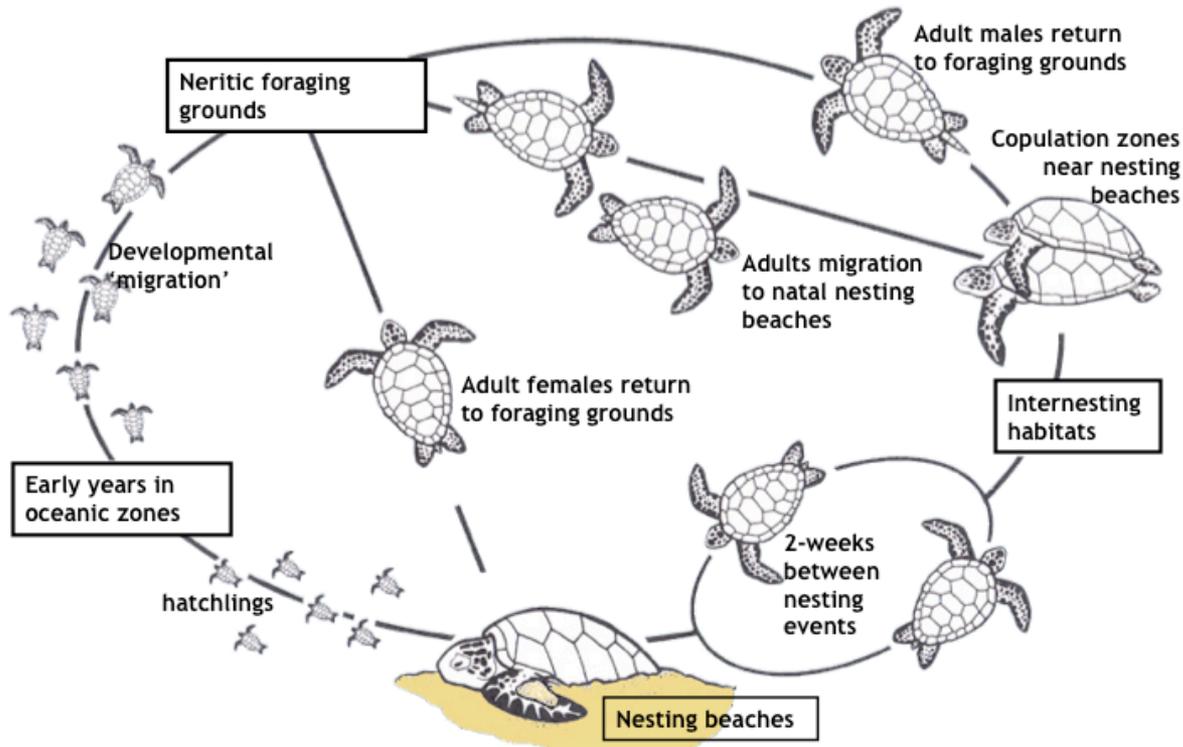
NRC Report (2010)



Turtle SAIP Report (2013)

# Sea Turtles 101

## Generalized sea turtle life cycle



Genetic evidence confirms natal homing

mtDNA good tool for characterizing nesting stocks



## **ESA Recovery Plan Priorities**

### **Define Stock Boundaries**

- Identify genetic stock of nesting beaches
- Determine nesting beach origins of juvenile and sub-adult populations
- Determine genetic relationships among populations (DPS, MU, DIP)

### **Monitor and reduce incidental mortality in commercial and recreational fisheries**

- Monitor and reduce incidental mortality in fisheries
- Identify nesting stocks (DPS, MU, DIP) impacted by fisheries in forage areas or migratory corridors

# Approach

- Develop suite of informative markers
  - mtDNA
  - nDNA – Microsatellites, SNPs
- Obtain representative samples
- Build baseline datasets
- Define DPS, MUs & DIPs



## **Emerging Issues: Towards DPS's**

### ESA

Loggerheads – 9 DPS's designated in 2011

Green turtles – 11 DPS's proposed in 2015

Other species to follow.....

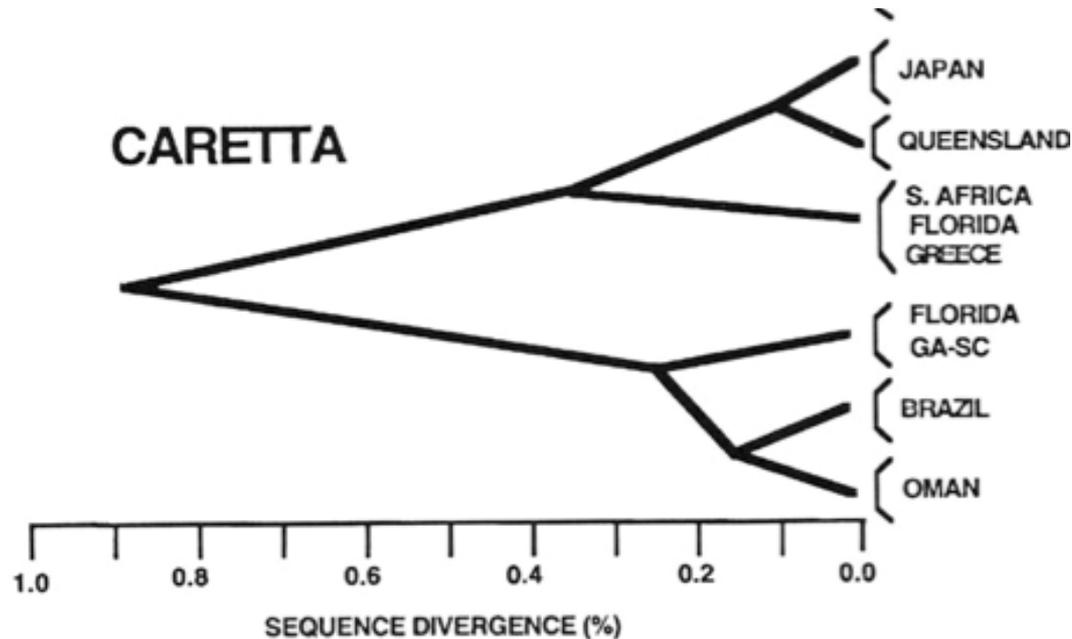
ESA

Pacific Loggerheads could be split into 2 DPSes

-based on criteria that each unit is “discrete” and “significant”

North Pacific

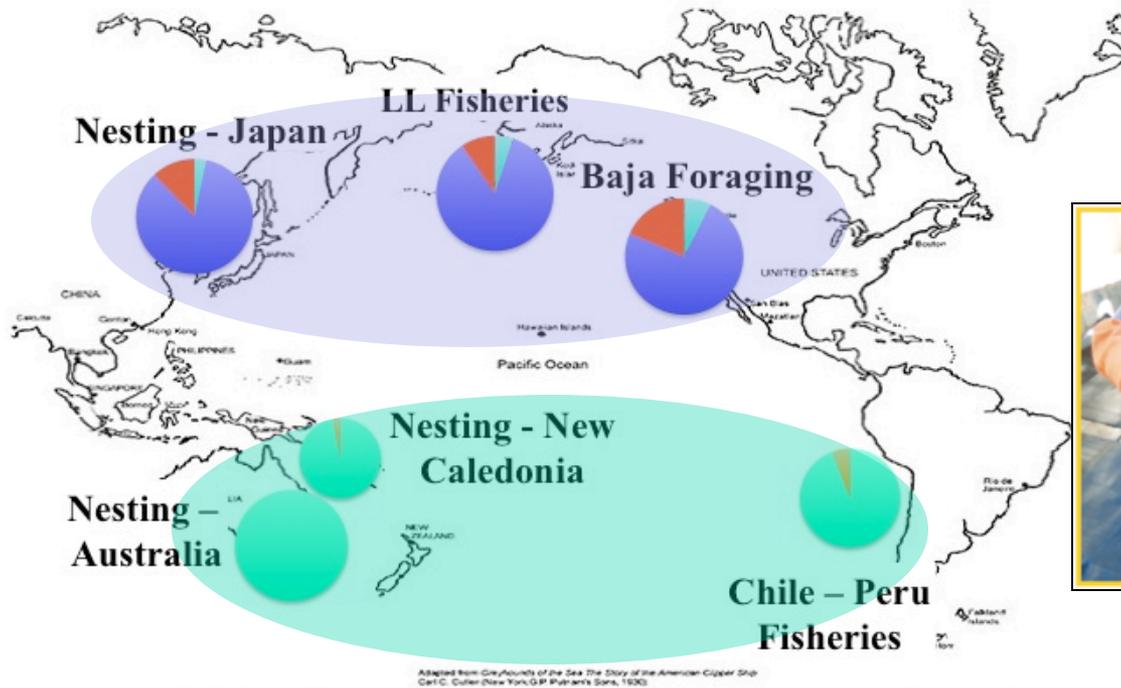
South Pacific





# Pacific loggerhead stock structure

## Linkages w/ foraging areas



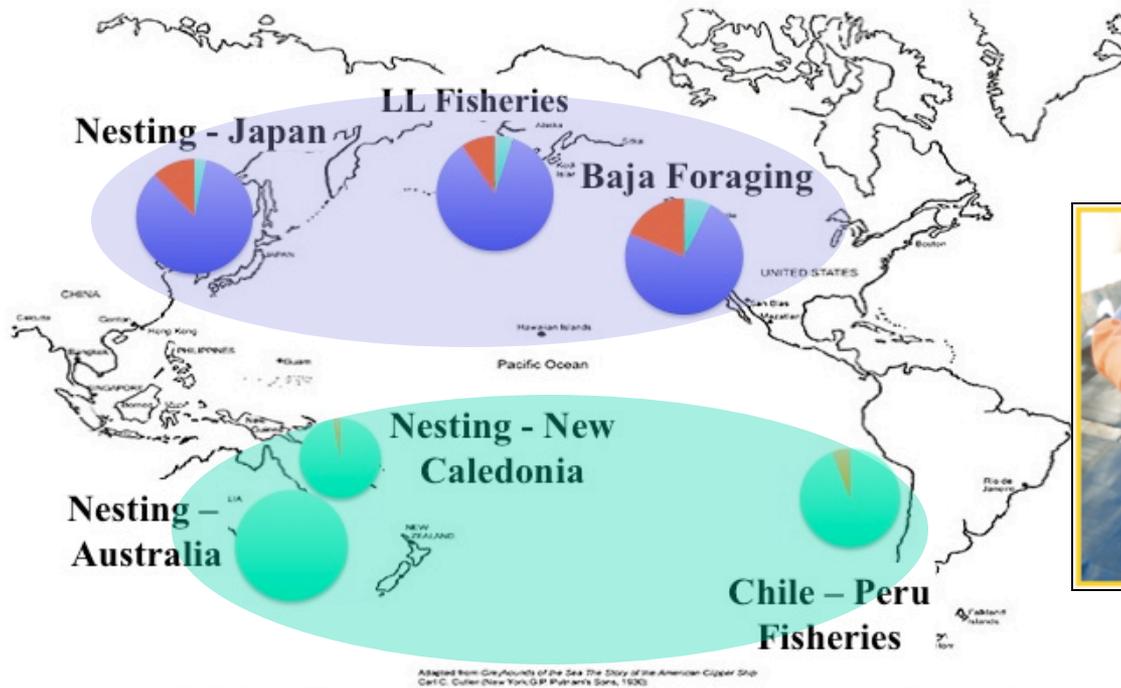
Bowen et al. 1995; Hatase et al 2002; Dutton et al 2004, unpublished

North Pacific stock – Japan nesting

South Pacific stock – Australia/N. Caledonia nesting

# Pacific loggerhead stock structure

## Linkages w/ foraging areas



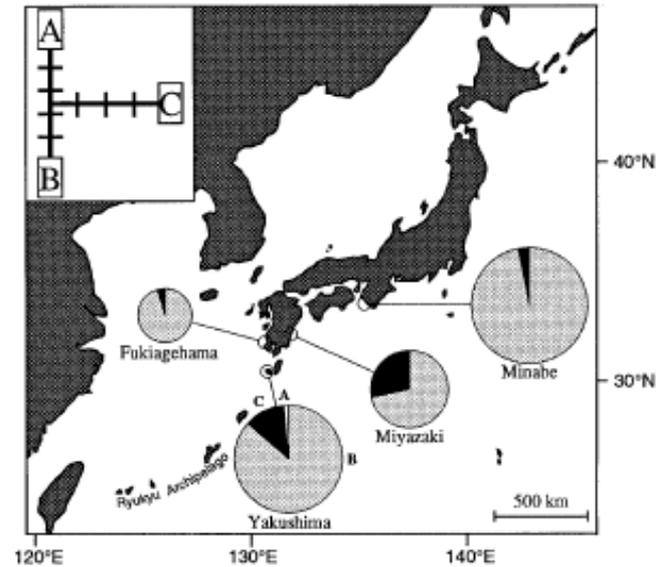
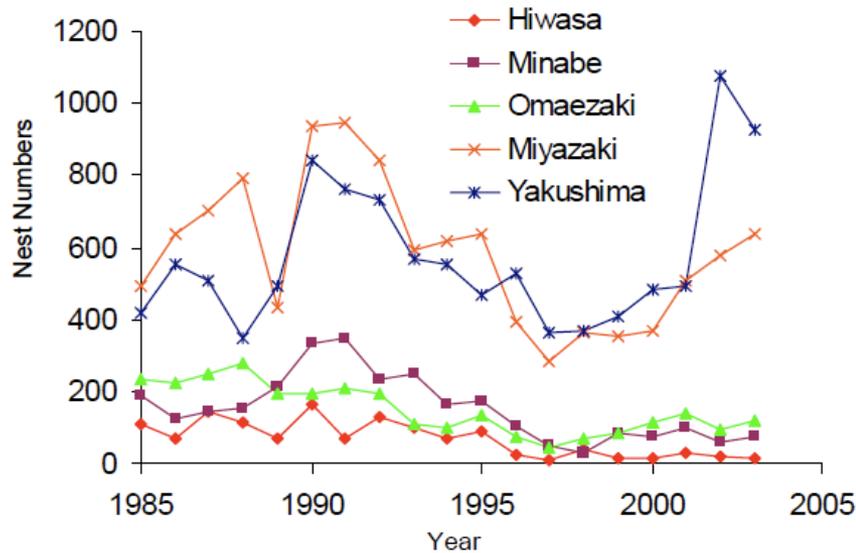
Bowen et al. 1995; Hatase et al 2002; Dutton et al 2004, unpublished

Risk Analysis (BiPOs, PBR) for HLL Fishery based on Population Assessment of Japan nesting population (MU) NW Pacific DPS)

# Pacific Loggerheads

## Management & Conservation

### Need to identify DIPs

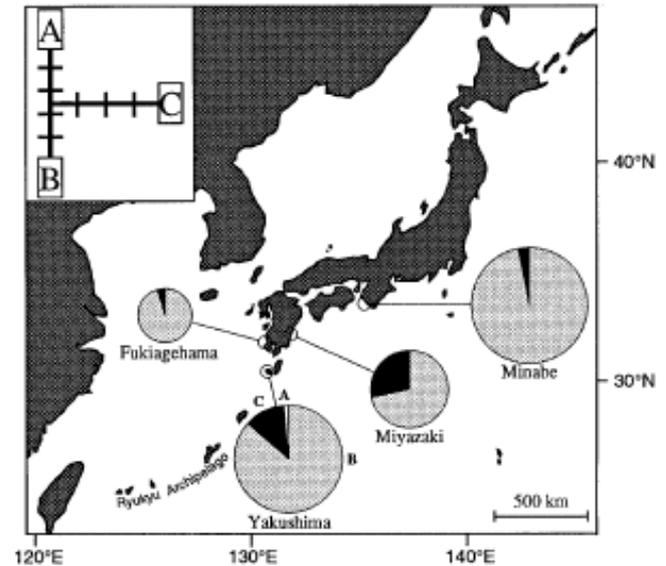
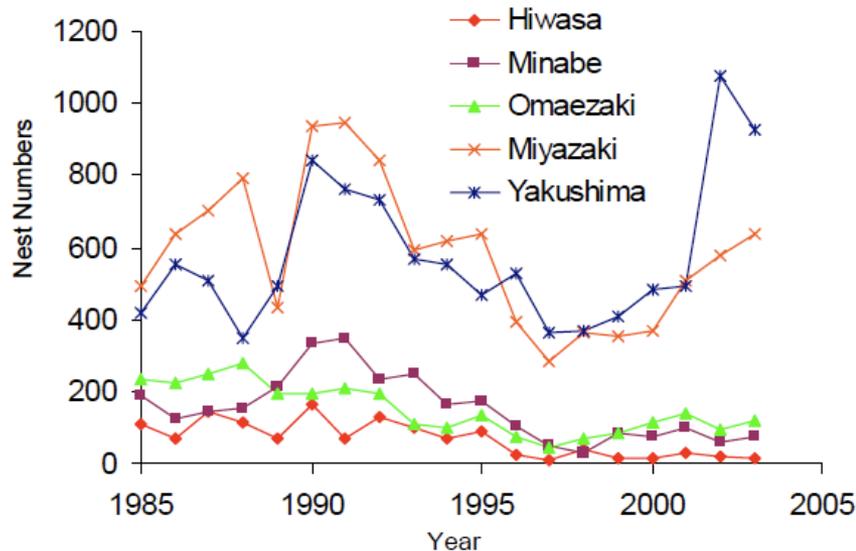


- Some evidence for regional demographic heterogeneity

# Pacific Loggerheads

## Management & Conservation

### Need to identify DIPs



- Can we genetically characterize DIPs?
- Can we assign bycatch (e.g. HLL) to source beach?

# Green turtles more challenging!

NMFS coordinating Pacific-wide green turtle stock structure (mtDNA) survey

- Approx. 4,400 rookery samples with mtDNA sequences completed
- International collaboration needed to address information gaps



Michael Jensen, SWFSC

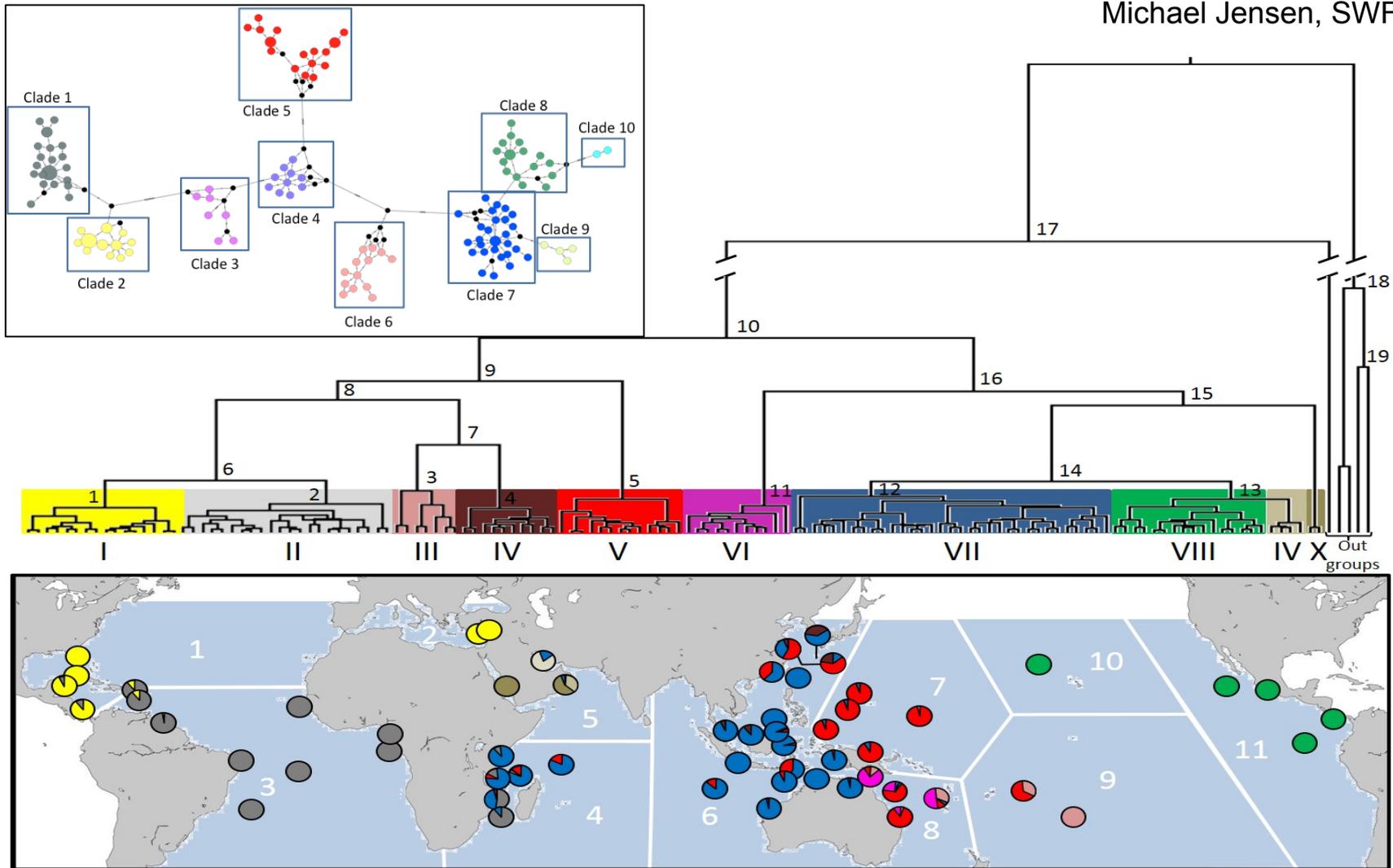


- SWFSC (Dutton) & U.Canberra (FitzSimmons) tissue collection – Long sequences
- Published literature – Shorter sequences
- Unpublished datasets currently unavailable

# Broader groupings of rookeries – Informing designation of DPSs - Green turtles (*C. mydas*)



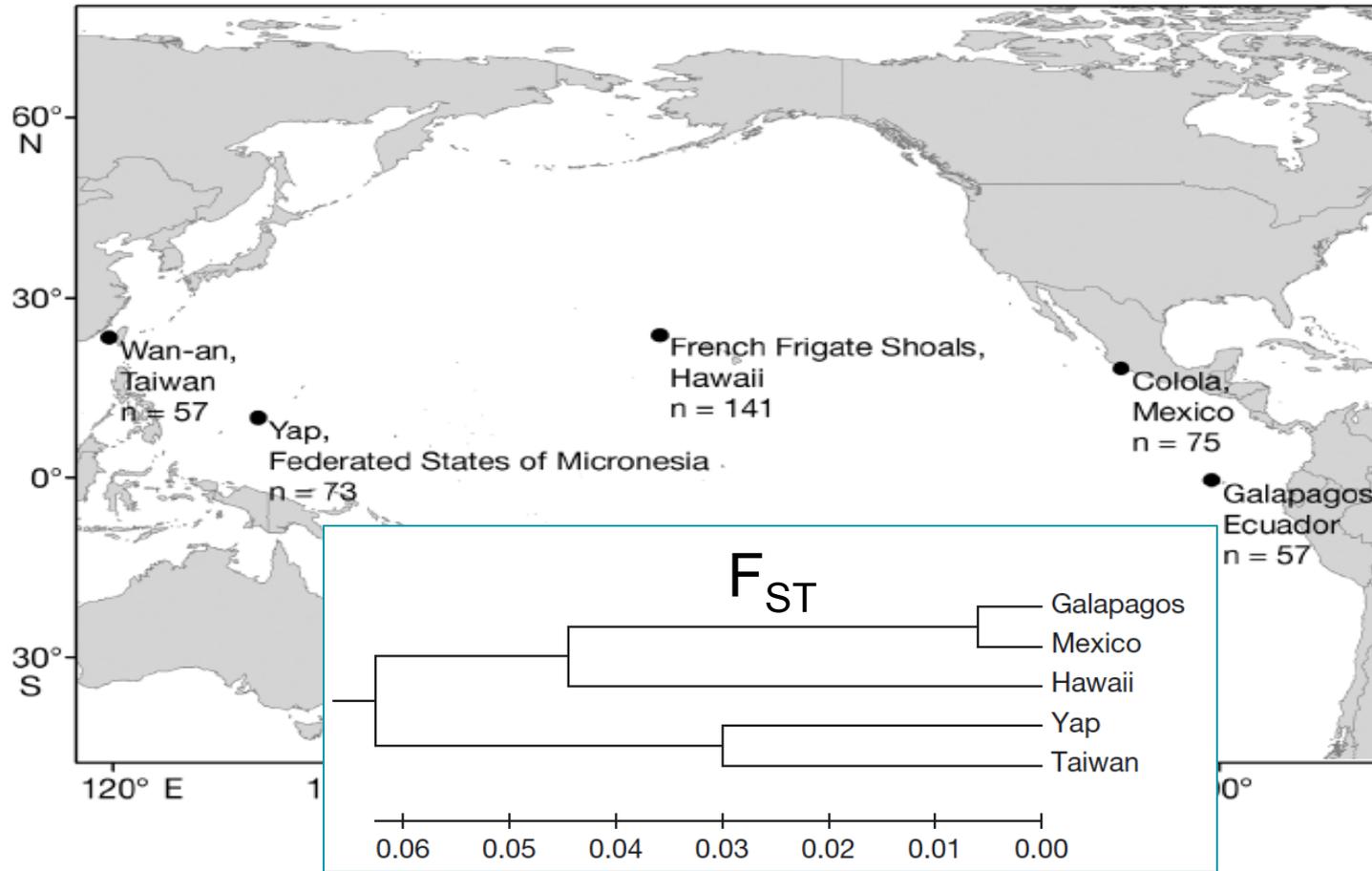
Michael Jensen, SWFSC



# Genetic tools needed

- mtDNA biased (female lineages)
- Male-mediated gene flow connects mtDNA nesting poplns (?)
- Need to combine mtDNA & nDNA
- mtDNA blunt tool for fine-scale structure

# Pacific Green Turtles: nDNA structure congruent with mtDNA



# Pacific Green Turtles: nDNA structure congruent with mtDNA

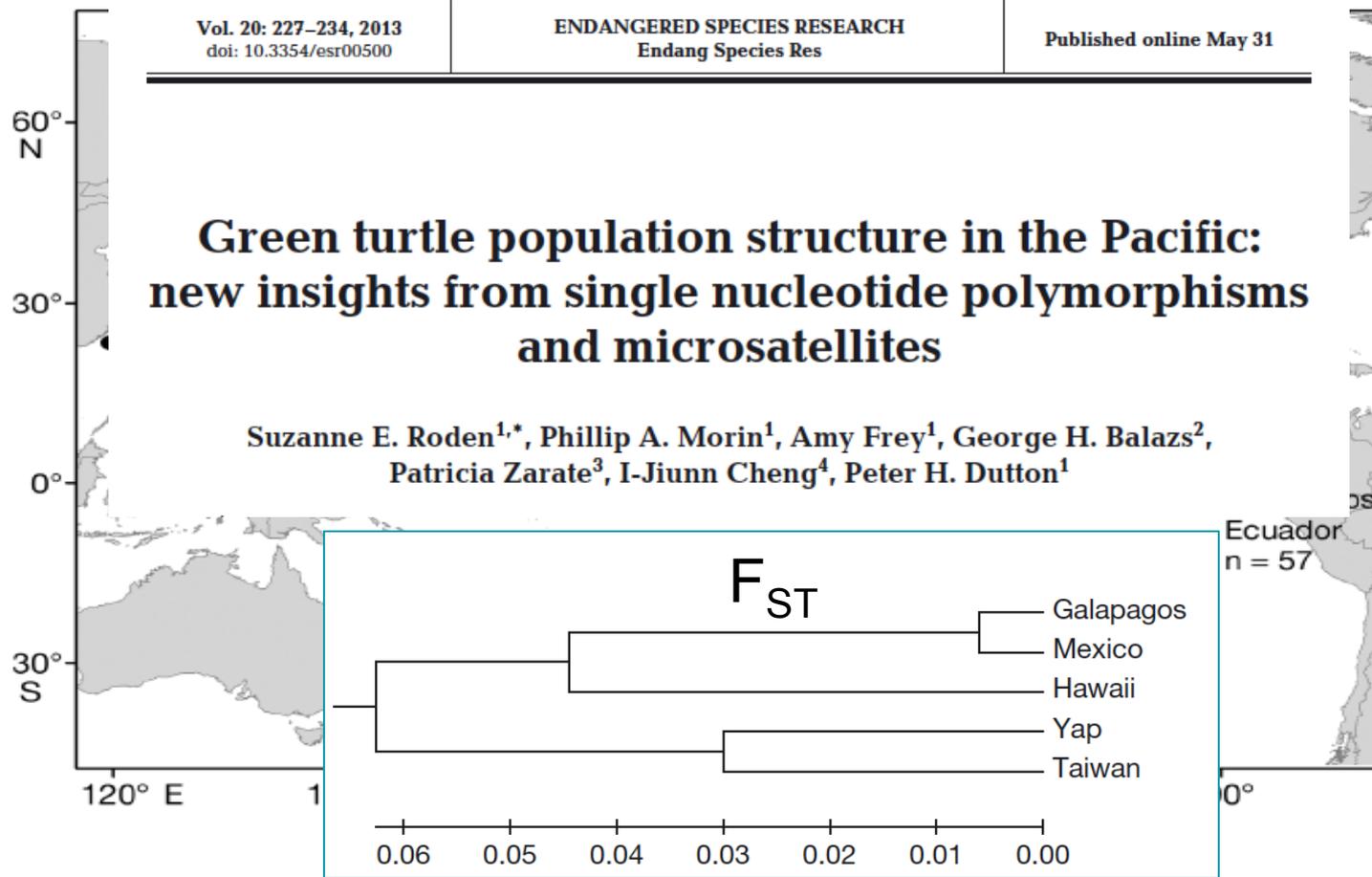
Vol. 20: 227–234, 2013  
doi: 10.3354/esr00500

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Endang Species Res

Published online May 31

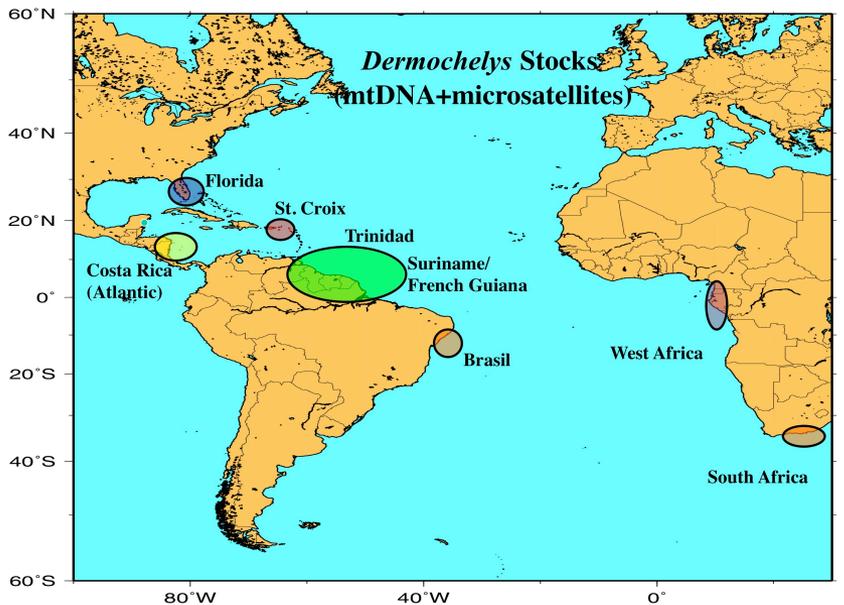
## Green turtle population structure in the Pacific: new insights from single nucleotide polymorphisms and microsatellites

Suzanne E. Roden<sup>1,\*</sup>, Phillip A. Morin<sup>1</sup>, Amy Frey<sup>1</sup>, George H. Balazs<sup>2</sup>,  
Patricia Zarate<sup>3</sup>, I-Jiunn Cheng<sup>4</sup>, Peter H. Dutton<sup>1</sup>

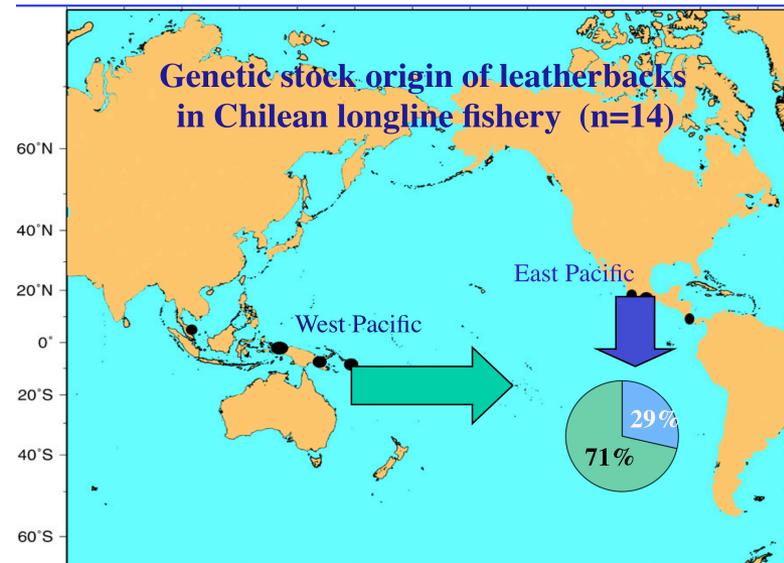


## Similar effort underway for other species

- Approx. 30 ongoing projects worldwide (see list)
- using longer mtDNA sequences (800 – 17,000 bp!)
- using additional nuclear markers (microsatellites, SNPs)



GMT Map created by Denise Parker, 10/02/00  
MTRP, NMFS, SWFSC Honolulu Lab



# Strengths

- Infrastructure
  - Managed Collection – comprehensive set of reference samples
  - In-house lab capacity (equipment & tech staff) =cost-effective
- NOAA Center for Marine Turtle Genetics
  - Serve needs for other Science Centers & regions
  - Innovators for development of lab & analytical tools
  - connected to local Biotech & Academia (San Diego)
- International recognition (leadership & capacity building)
  - Extensive network of collaborators & partners
  - Publication record
  - Coordination & dissemination of global baseline datasets
- Proactive engagement on management issues

# Challenges

- Maintaining Capacity (Infrastructure & personnel)
- Keeping up-to-date with emerging technologies
  - Also processing/storing increasing scales of data generated
  - Using appropriate markers for different questions
- Obtaining representative samples for robust experimental design- particularly for delineating oceanic stock boundaries and assessing fisheries bycatch
- CITES processes –impediment to timely progress and sample acquisition
- Travel restrictions = erosion of leadership role-international collaboration

# Strategies

- Develop novel approaches for using genetics to address broader science and management questions
  - (e.g. population vital rates – NMFS Research Plan for Marine Turtle Stock Assessments – NRC Report)
- Identify new platforms for collecting samples at sea (fisheries observers, stranding networks, etc)
- CITES-build international in-country capacity and collaboration

# Strategies

- Hire Post docs (\$ dependent) – to fill short term analyst needs
- Increase efficiencies (cost-sharing) across Programs and Science Centers to maintain core genetics lab support
- Build new partnerships (\$\$) with non-NOAA entities
  - (Ocean Foundation, Pew-Lenfest, USGS, USFWS, Regional Initiatives (SER/C+NEC/GARFO + Army CORPS Eng)

# Today's Case Studies



Delineating stock boundaries: Pacific green turtles  
**Michael Jensen**



Putting new populations on the map: Eastern Pacific hawksbill turtles - **Alexander Gaos**



Building comprehensive international datasets:  
Loggerhead turtles - **Peter Dutton**



Fine-scale stock assignment with multiple markers:  
Leatherback turtles – **Peter Dutton, Kelly Stewart**