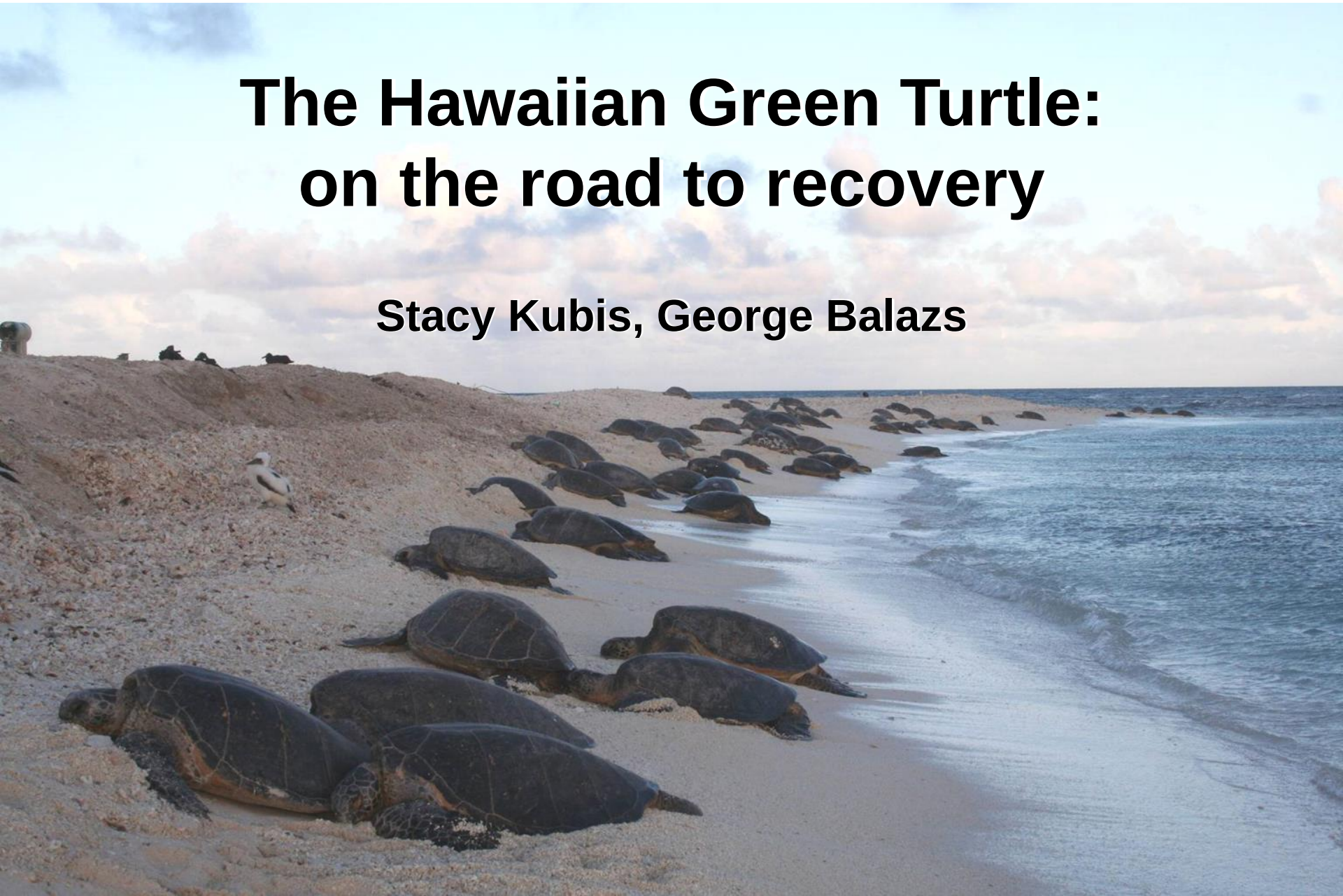
The Hawaiian Green Turtle: on the road to recovery

Stacy Kubis, George Balazs



"…it appears that Hawaii has one of the few *Chelonia* populations in which protection is not complicated by international migrations…With both the feeding pastures and breeding grounds under the jurisdiction of a single country, one would hope to find a healthy population that has not undergone ecologic decline. Unfortunately, Hawaii's green turtles have nevertheless experienced serious losses…"

~ Defenders of Wildlife, 1975

History

- Hawaiian Islands Bird Reservation established by T. Roosevelt in 1909 – changed name to HINWR in 1940
- Nesting habitat destruction at FFS thru 1960s
- Females and eggs harvested until 1959 – USFWS permanently assigned to FFS in 1964
- Annual surveys of nesting females - 1973
- Harvested on foraging grounds until 1974; home consumption still allowed
- ESA listed 1978

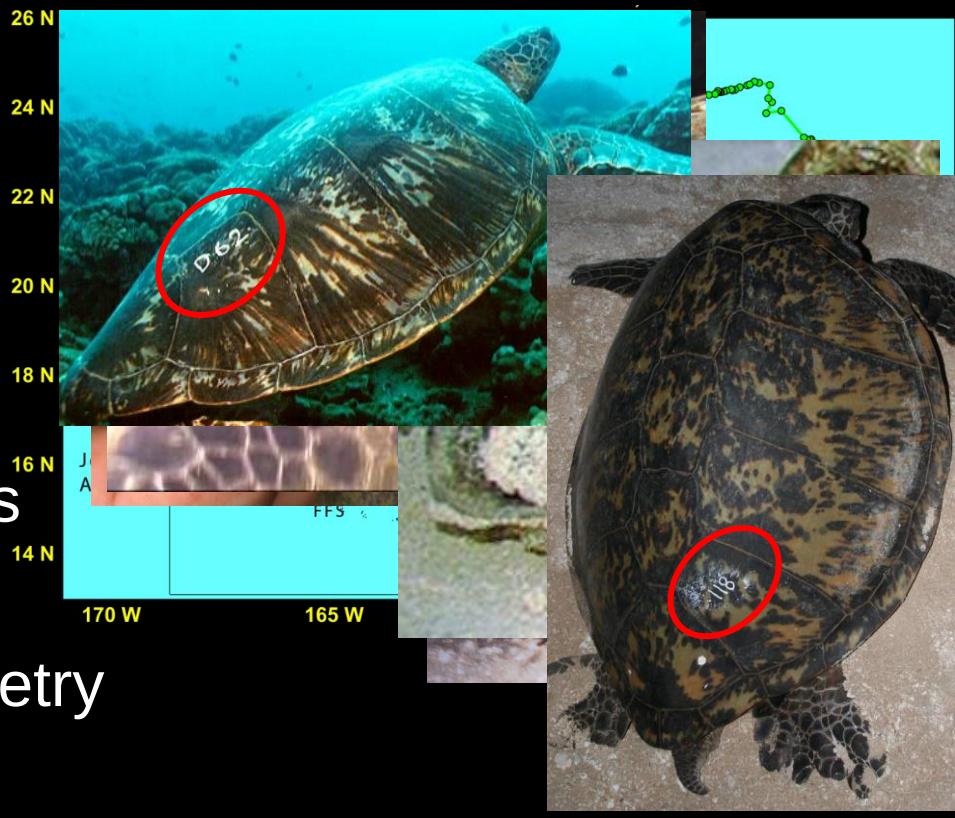
How many green turtles are there in Hawaii?

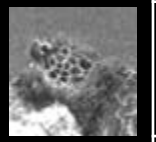
Population Abundance Estimates

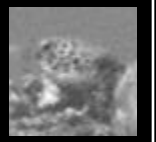
- Trawl-based CPUE estimation
- Aerial survey-based density estimation
- Capture-mark-recapture on foraging grounds
  - Difficult & expensive
- Count nesting females
  - Easiest & least expensive

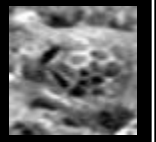
Connecting the Foraging Grounds and Nesting Beaches

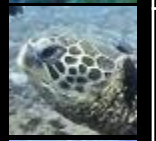
- mtDNA
- ID Individuals
  - Tags
  - Mototool
  - Head Scales
- Satellite Telemetry





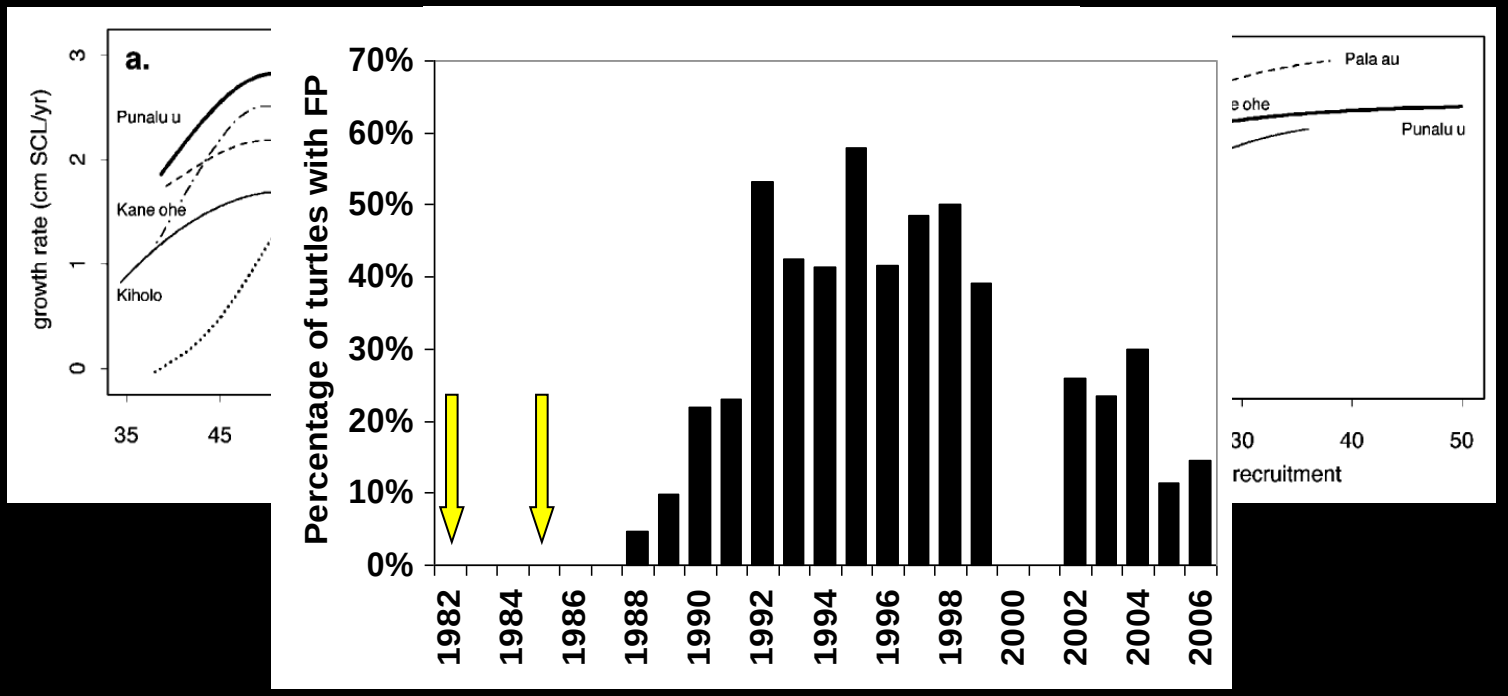






Annual records for Tutu U521	
1990	First sighted at the Turtle House. Tagged female. Tumors on both eyes and one tumor near tag on right front flipper. Overall Tumor Score Light
1991	**Nesting, French Frigate Shoals**. 6/2/91, 6/18/91, 7/4/91, 7/16/91, 7/29/91, 8/13/91
1992	Resighted at the Turtle House. All tumors improved. ***First Honokowai regression case.***
1993	Resighted at the Turtle House. Read one tag for the first time. Regression continues.
1994	**Nesting, French Frigate Shoals**. 6/25/94. Resighted at Honokowai on 8/25/94. Eye tumors completely gone. Tumor on right front flipper barely noticeable. Regression continues.
1995	Resighted on second dive. Accepted our presence easily. Regression complete, no visible tumors. New tags read July 15. She is turtle U521 (left rear tag).
1996	**Nesting, French Frigate Shoals**. 6/15/96, 7/2/96
1997	Resighted quickly as fourth turtle of the summer. Regression holds.
1998	Resighted July 3rd dive. Several white blemishes on neck and shoulders. Fear of FP relapse!
1999	**Nesting, French Frigate Shoals.** 6/8/99, 6/23/99. Resighted at Honokowai on 8/27/99.

Results of foraging ground studies



- 25-35 yr generation period
- Declining somatic growth rates over time
- Incidence of FP peaked during past 20 years

Population Abundance Estimates

- Trawl-based CPUE estimation
- Aerial survey-based density estimation
- Capture-mark-recapture on foraging grounds
  - Difficult & expensive
- Count nesting females
  - Easiest & least expensive
    (but not easy or inexpensive)

Horvitz-Thompson type estimator

$$N_i = n_i/p_i$$

where:

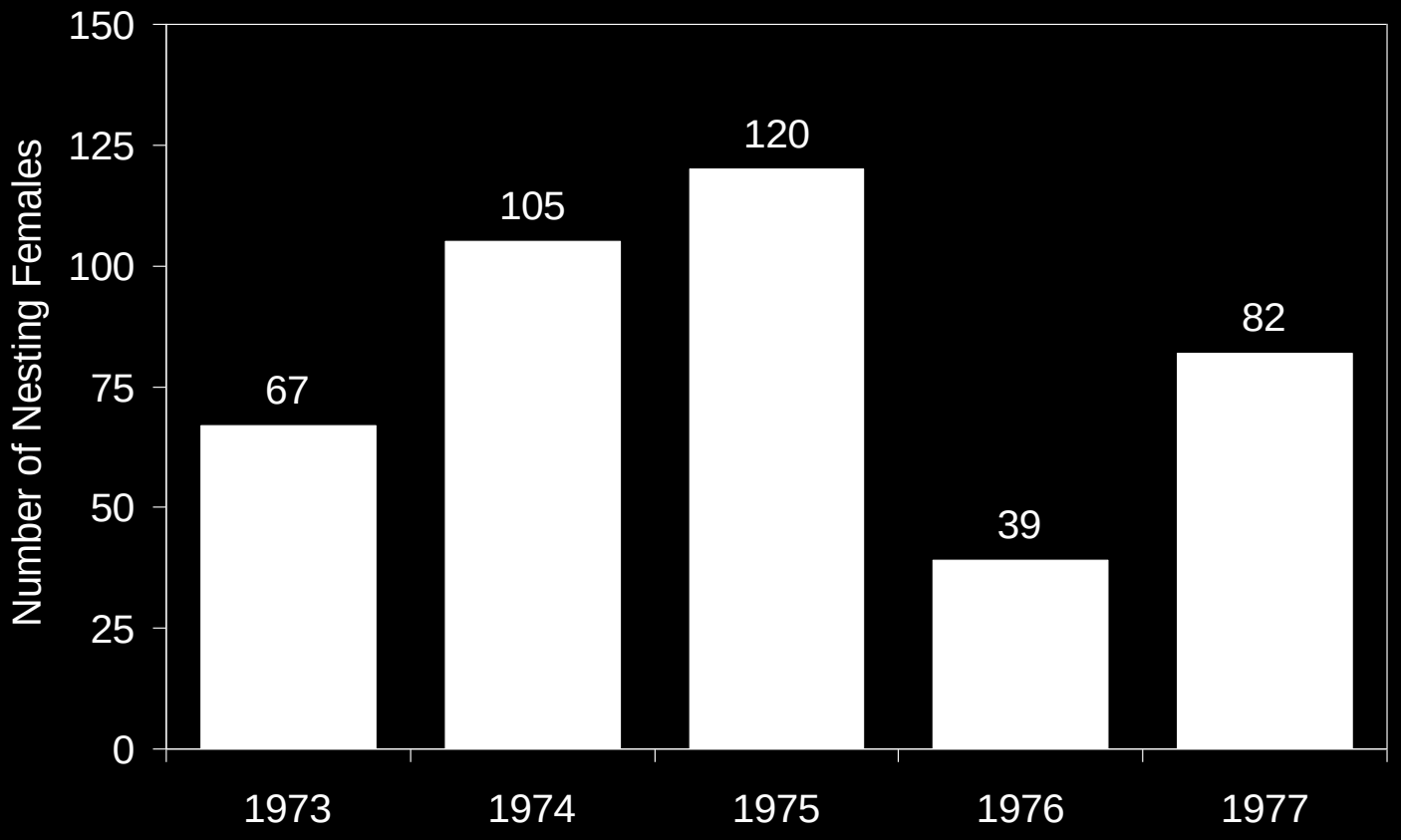
N_i = estimated number of female nesters in the *i*th year

n_i = number of uniquely identified female nesters recorded for the *i*th year

p_i = probability of sighting a female that emerges and nests at least once during the *i*th year

(Wetherall et al. 1998)

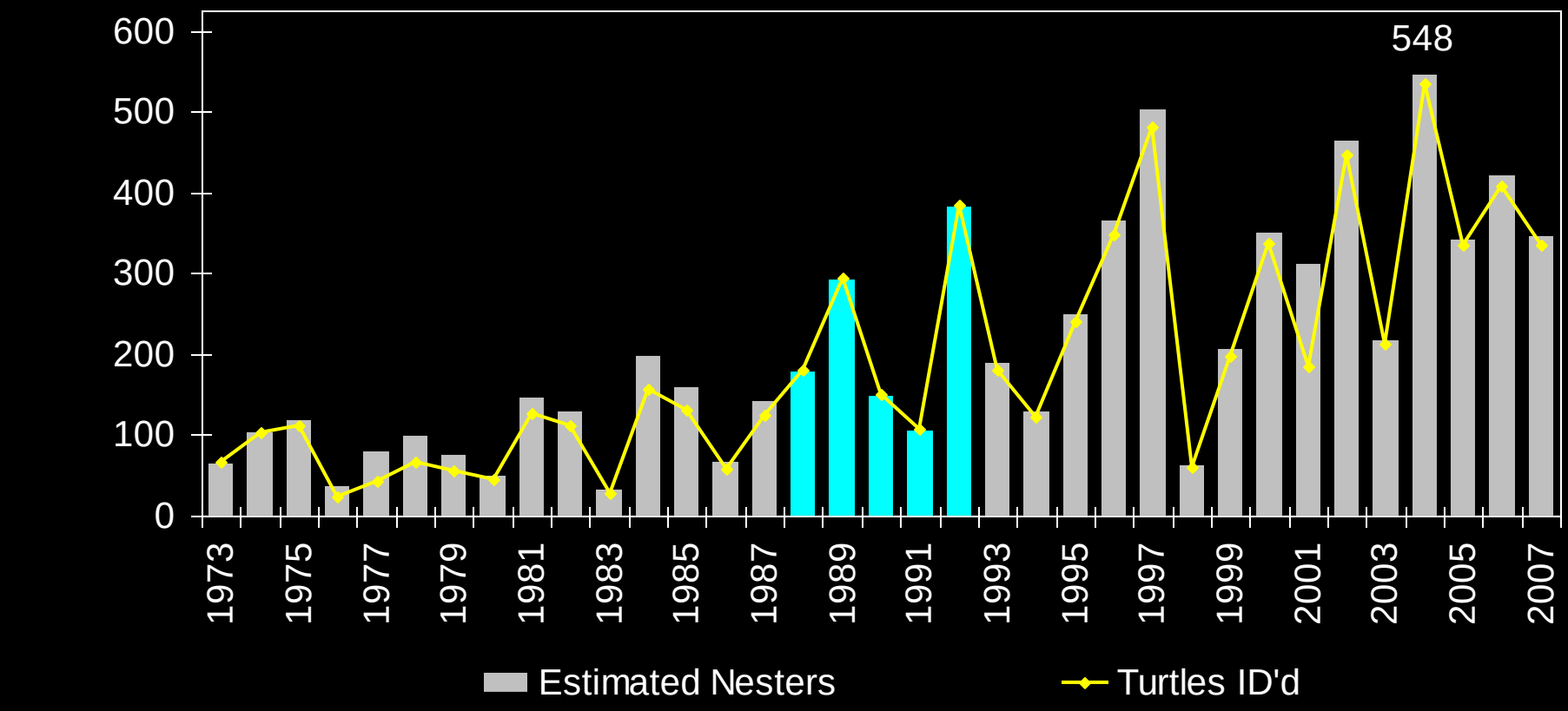
Green Turtles Nesting at East Island, FFS: Before ESA Protection



Early results

- FFS accounts for >90% of all nesting within the Hawaiian Archipelago
- East Island accounts for 50% of all nesting at FFS
- Strong island fidelity within the regional rookery
- Hawaiian green turtles are an isolated reproductive stock; later confirmed with genetics

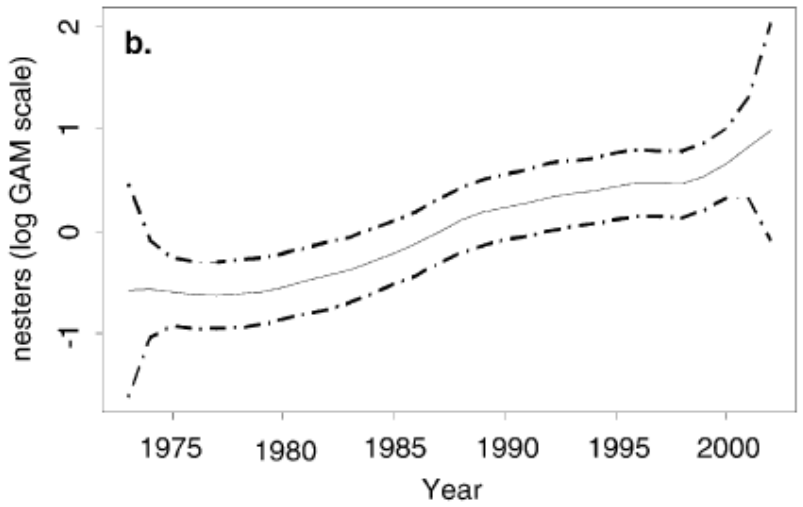
Green Turtles Nesting at East Island, FFS (1973-2007)



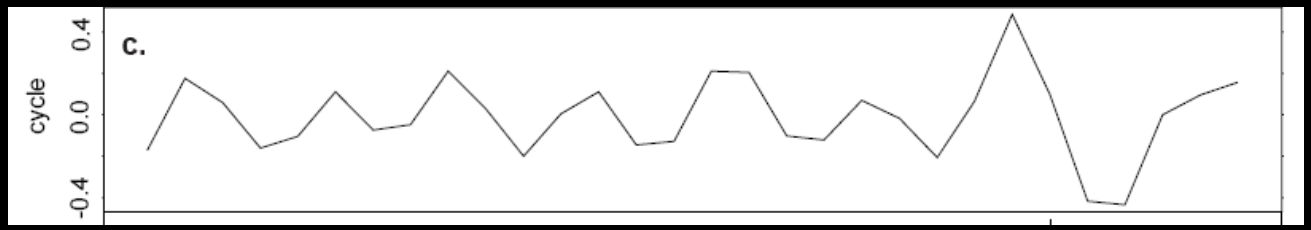
Results

The estimated long-term trend in Horvitz-Thompson nester abundance derived using a Bayesian nonparametric regression model (Fahrmeir and Lang, 2001), which was fitted to the Horvitz-Thompson nester series. Solid curve is the posterior mean annual nester abundance derived from the model with a Bayesian 95% credible region shown by dashed curves (posterior 2.5th-97.5th quantiles).

(Balazs and Chaloupka 2006)



- Near-linear increase in annual nester abundance over the last 30+ years (~ 5.7% pa)

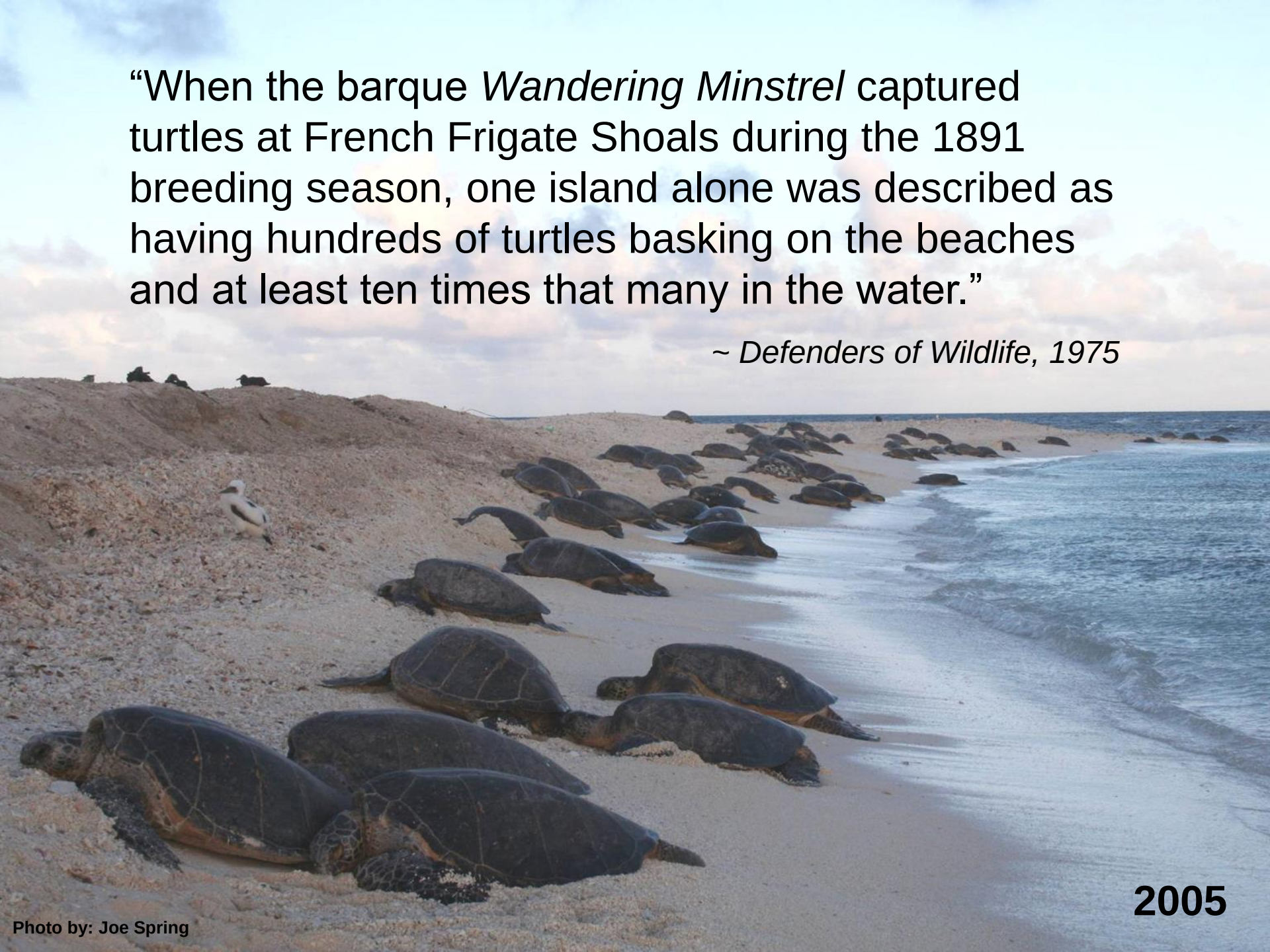


- Substantial fluctuations in the number of annual nesters

Balazs and Chaloupka – 2004, 2006

Future Research

- Continue monitoring nesting population at index site
- Survey other islands for nesting and basking activity
- Assess reproductive/hatching success
- Assess sex ratios of hatchlings
- Estimate hatchling predation rates in near shore waters
- Conduct multi-year saturation surveys to recalibrate Horvitz-Thompson parameters (repeat every 10 yrs)
- Initiate a beach carrying capacity study at East Island
- Continue use of and upgrade satellite-linked remote viewing and thermal imaging cameras at East Island, FFS



"When the barque *Wandering Minstrel* captured turtles at French Frigate Shoals during the 1891 breeding season, one island alone was described as having hundreds of turtles basking on the beaches and at least ten times that many in the water."

~ Defenders of Wildlife, 1975

2005

Photo by: Joe Spring