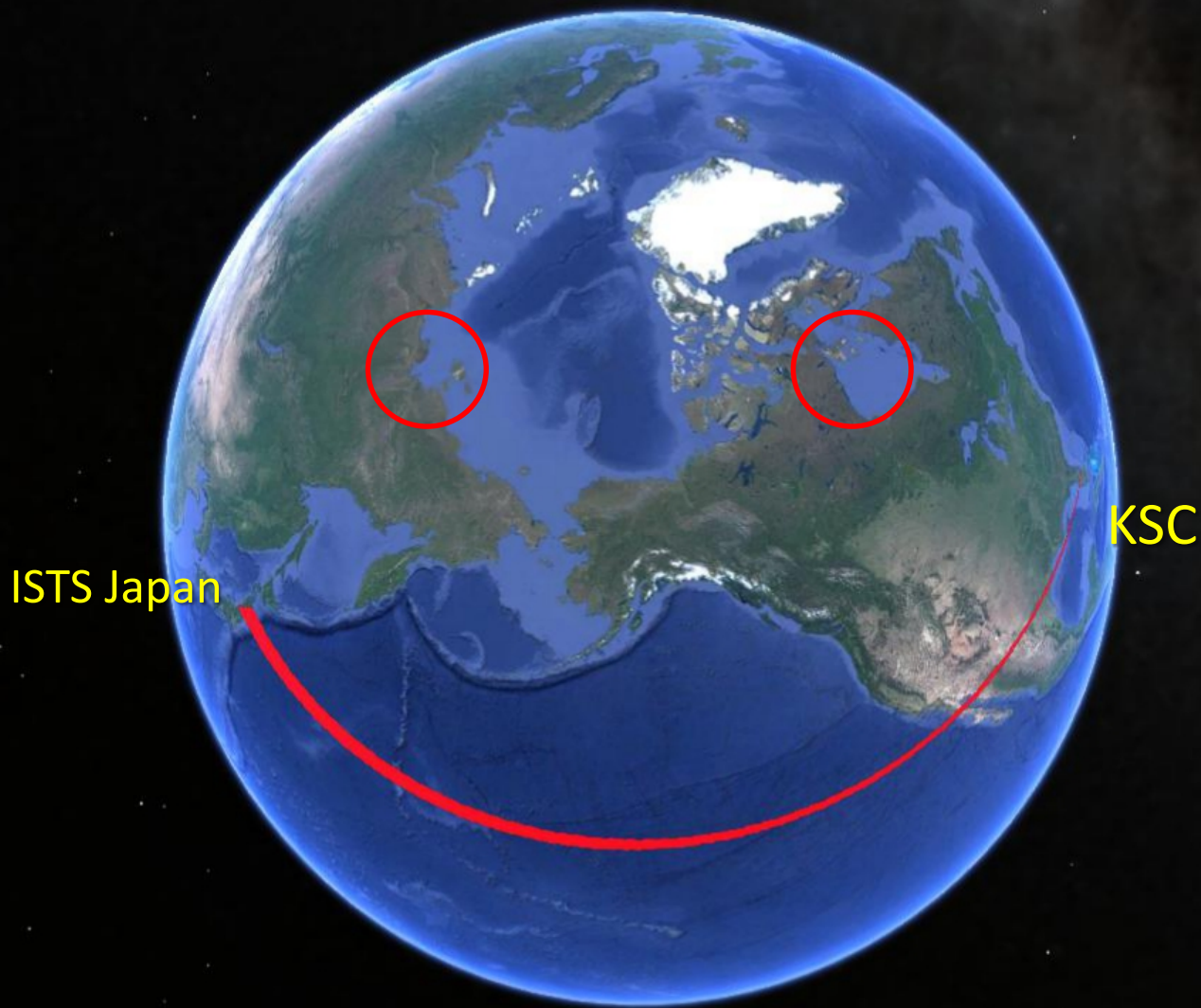


NASA Kennedy Space Center Contributions to Sea Turtle Science and Conservation

Jane A. Provancha and Lynne V. Phillips

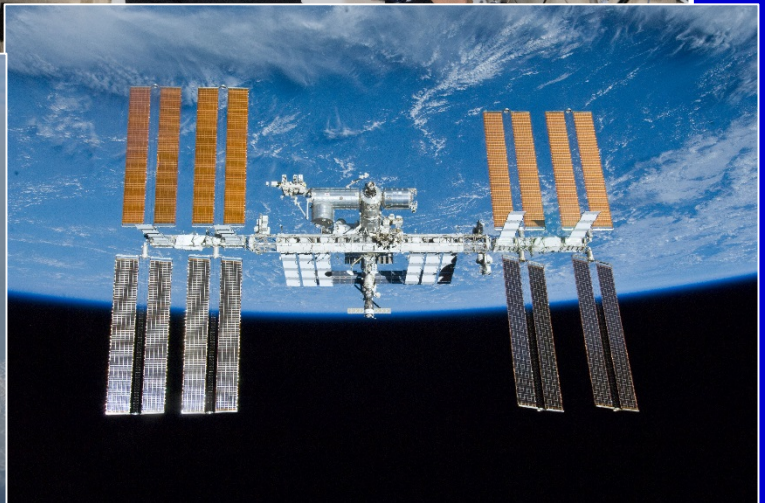
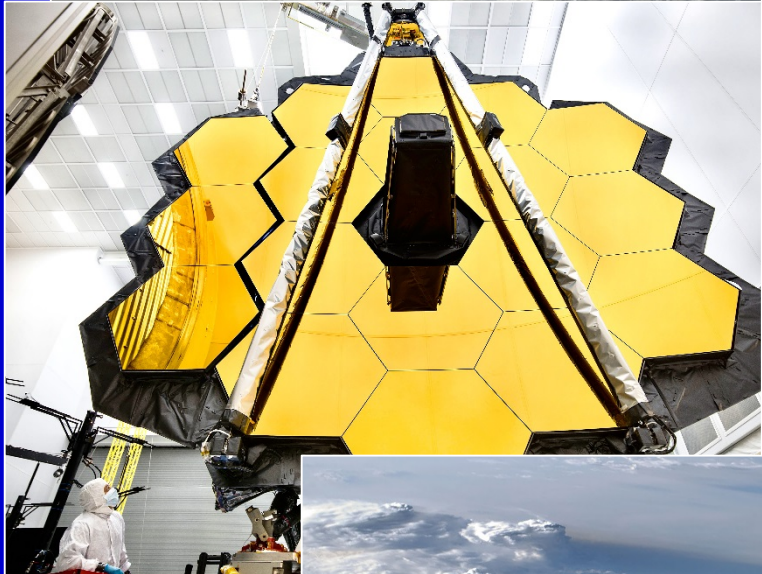
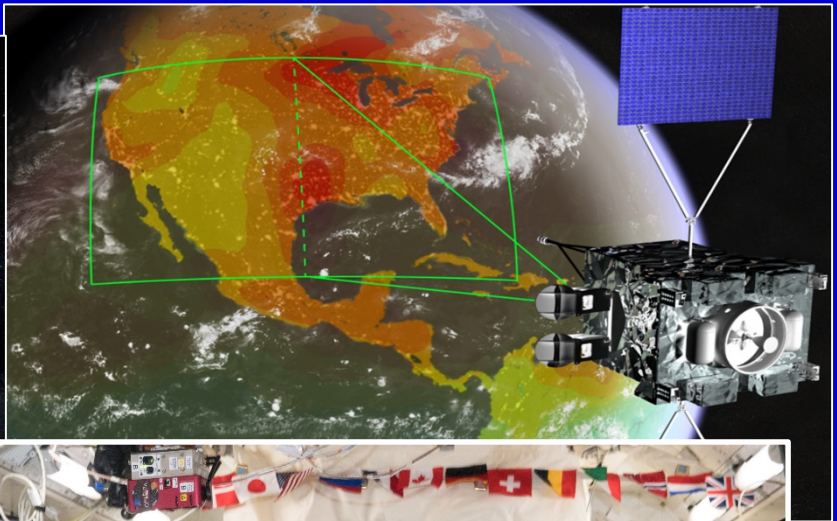
Presenter
Jane Provancha





ISTS Japan

KSC





?

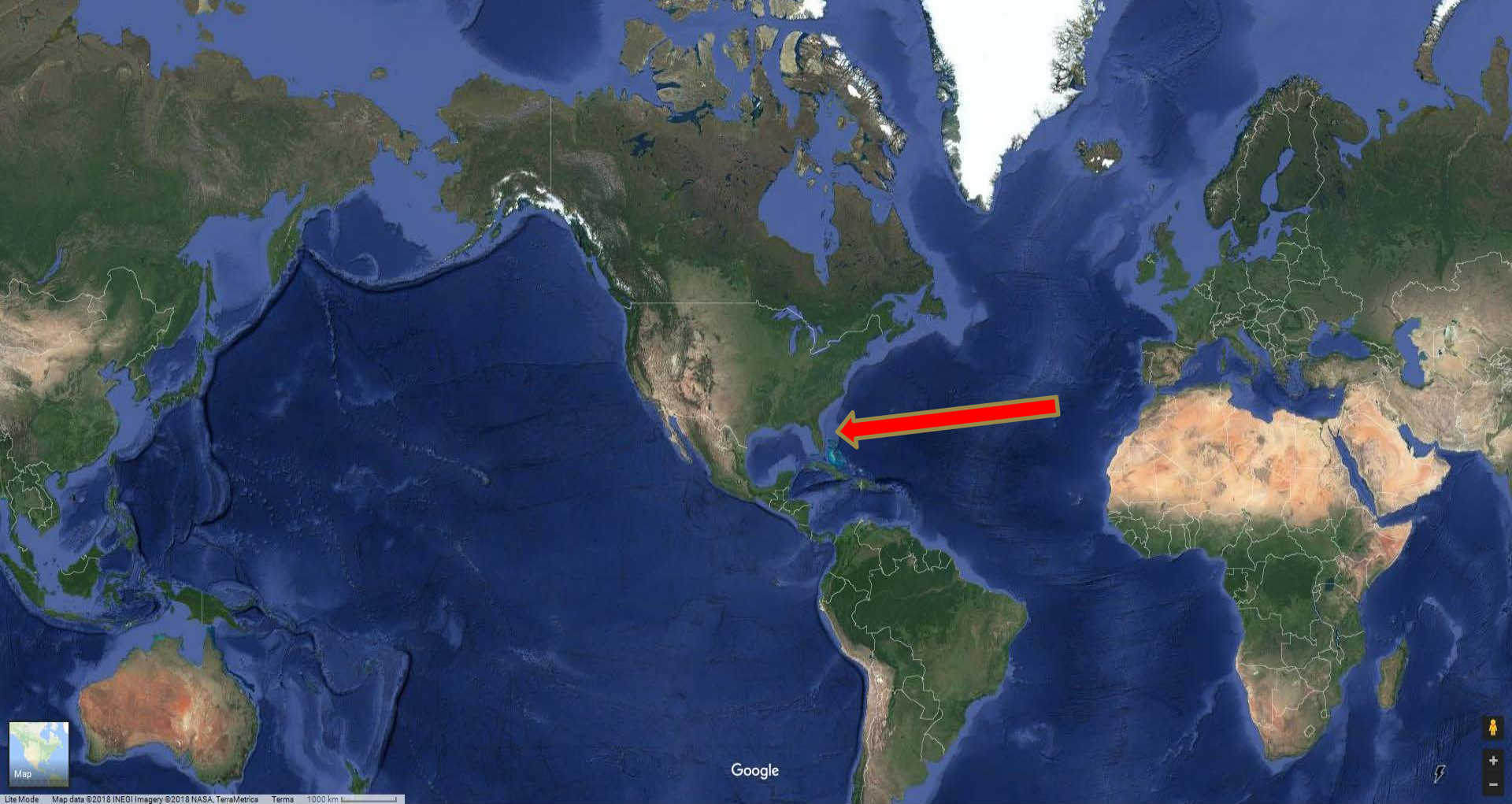


KSC GO – YOU TUBE VIDEO

KSC MISSION STATEMENT

- ❑ KSC safely manages, develops, integrates and sustains space systems through partnerships that enable innovative, diverse access to space and inspires the nations' future explorers.

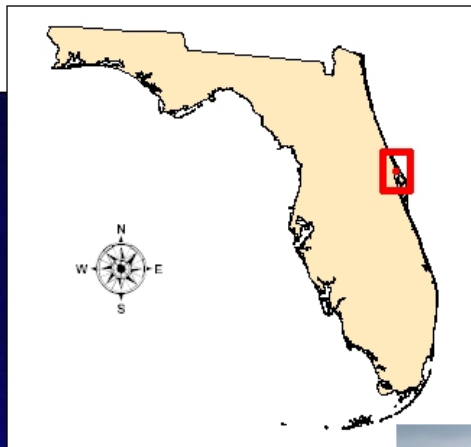
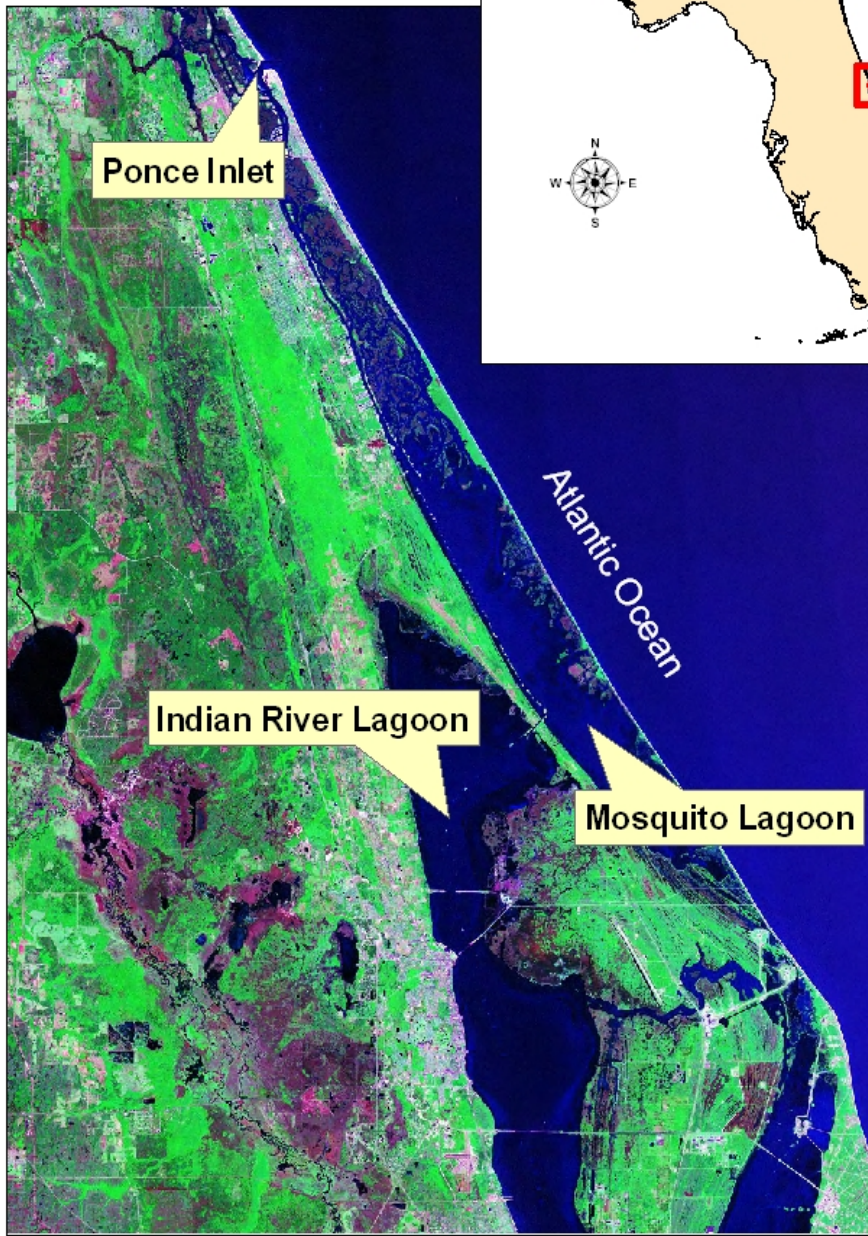




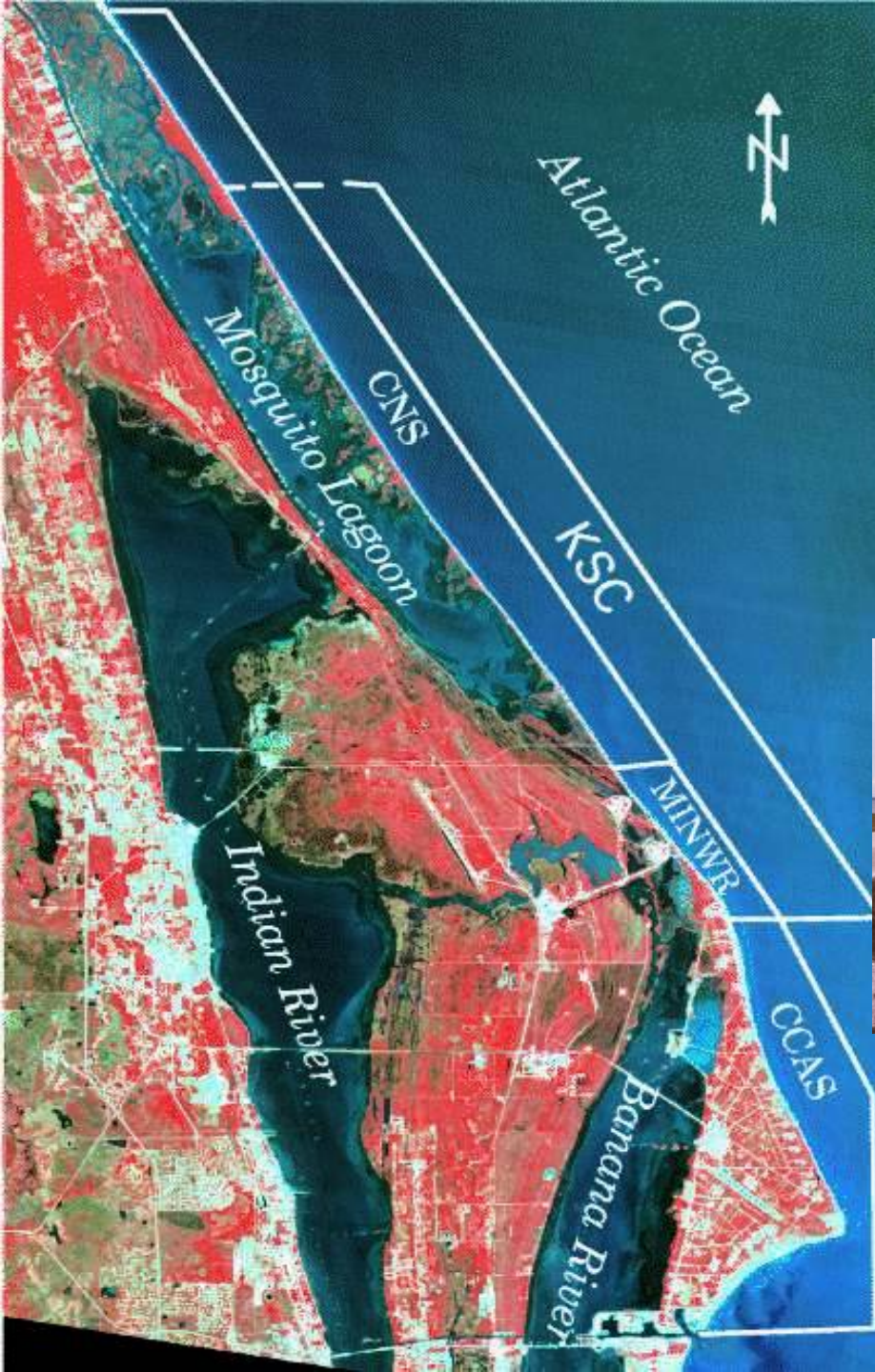
Kennedy Space Center, Florida, USA, Western Atlantic Basin

Location ideal for equatorial orbits -- the low latitude makes it easy to use the Earth's rotation as a speed boost to launch large rockets

Transition zone between temperate and tropical regions







67 kilometers of continuous federal beach

- (KSC is subset)

Multiple land managers by:

- NASA
- Merritt Island National Wildlife Refuge (USFWS)
- Canaveral National Seashore (NPS)
- Cape Canaveral Air Force Station (USAF)





In the early 1960s:

- US was becoming more aware of and committed to protecting the environment
- NASA was developing KSC for launching and testing rockets

The US began creating regulations that required the consideration of the environment when taking action on federal land or with federal funds.

The two very powerful acts were:

NEPA or National Environmental Policy Act (1969)

ESA or Endangered Species Act (1973)

NEPA-1969 one of the first US laws to establish the broad national framework for protecting our environment. ----to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment.

ESA -1973 superseded earlier acts, broadening & strengthening protection for all plant & animal species listed by the US as threatened or endangered,

- prohibited take and trade without a permit,
- **required Federal agencies to avoid jeopardizing their survival,**
- required actions to promote species recovery.

NASA KSC: 1972-1976 –

NASA was preparing the SPACE SHUTTLE TRANSPORTATION SYSTEM for operation and simultaneously an ENVIRONMENTAL IMPACT STATEMENT to comply with NEPA

Early focus at NASA KSC was:

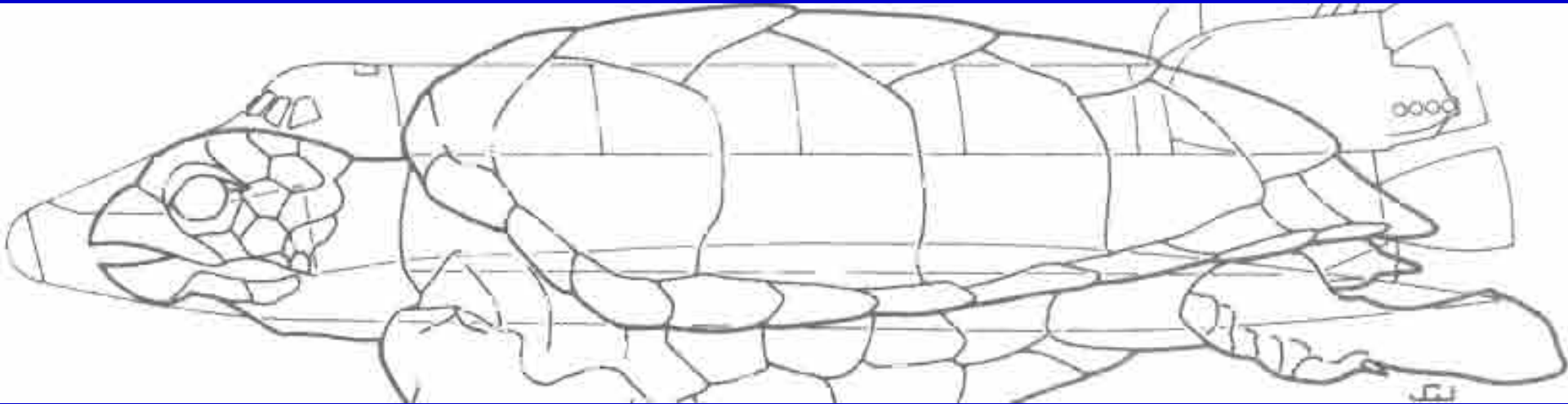
Environment - WHAT, WHERE, HOW MANY, and WHAT IF?

- KSC fauna and flora baseline studies performed by University of Central Florida (then Florida Technological University). IT was discovered that many species of local and global importance were observed here – including Sea Turtles

KSC THEN NEEDED TO UNDERSTAND:

- WHAT ARE THE CONSERVATION & REGULATORY NEEDS ?
- WHAT IS RELATIVE IS IMPORTANCE OF KSC to SEA TURTLES ?

NOAA Technical Report NMFS 53
Ecology of East Florida Sea Turtles
*Proceedings of the
Cape Canaveral, Florida
Sea Turtle Workshop
Miami, Florida
February 26-27, 1985*



Cover page art on this original NOAA document that pulled sea turtle scientists together to share knowledge about the Cape Canaveral area and sea turtles

DO YOU SEE A SHUTTLE OR A TURTLE ?

Since 1972 - KSC has supported in various ways, MANY sea turtle studies via full funding, in-kind sharing, or simple collaborations, and partnerships

Ehrhart & students (UCF) 1977-84...sea turtle stranding network development

McGeehee (UCF) 1979...factors affecting hatching success of loggerheads

Demmerer (UCF) 1981...hatching and emergence of loggerhead turtles

Mendonca (UCF) 1983...movements and feeding ecology of immature greens

Wetzel et al. (NOAA) 1985...ecology of east florida sea turtles

Murphy & Hopkins (SCDNR & USFWS) 1984...aerial survey groundtruth nest counts

Provancha (USFWS) 1985...sea turtle nest predator control assessment

Provancha & Ehrhart (UCF) 1987...nest trends & factors influencing nest site selection

Galloway (NOS-NOAA) 1986...first baseline blood profiles from healthy nesting females

Mrosovsky & Provancha (UToronto) 1989-92 ...hatchling sex ratios & climate

Ratneswamy (UGA, NPS) 1995... raccoon depredation on turtle nests

Provancha et al. (NASA) 1995-present...abundance, distribution of juvenile sea turtles

Valverde et al. (TAMU) 1996...stress in sea turtles

Provancha (NASA) 1999...sea turtles and habitats in transition

Mota -for Bolton & Bjorndal (UF) 2001-4...genetics & turtle management units

Mota (UF) 2009...beach restoration effects on nesting/hatchling physiology

Provancha et al. (FWCC) 2005, 2012...turtle cold stun response

Holloway-Adkins & Provancha (NASA) 2012...foraging ecology of Lagoon green turtles

Bjorndal et al. (UF et al.) 2013...temporal, spatial, & body size effects on Cartha growth rates

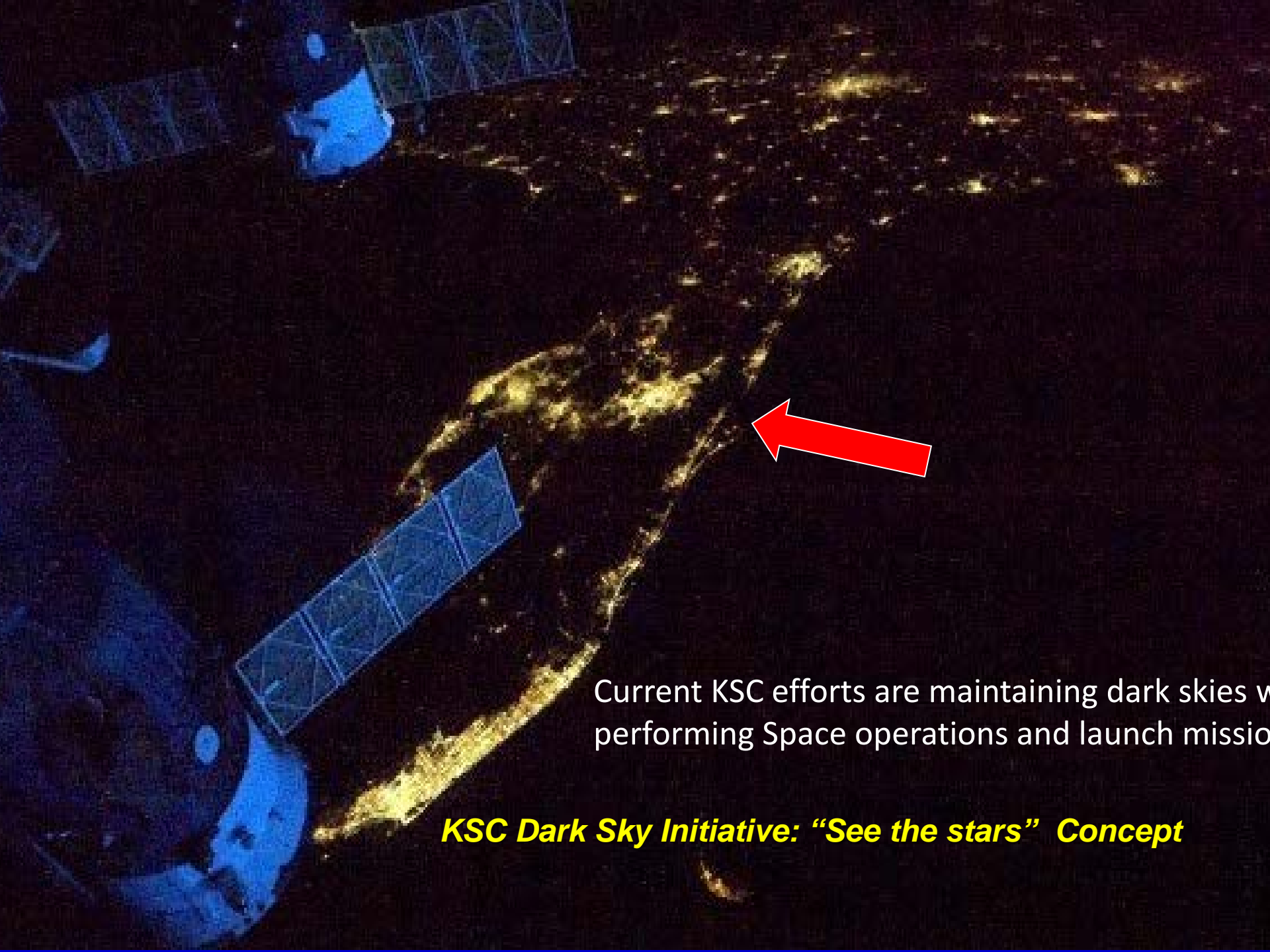
Holloway-Adkins (FAU) 2014...grazing effects of fish & green turtles on marcoalga communities

Bjorndal et al. (UF et al.) 2017...ecological regime shift & declining growth rates of sea turtles

Provancha/Mota/Holloway/Mercadante (NASA) 1995-2018...exterior lighting impacts/control

Watwood, Provancha, Holloway, Iafrate (NAVY) 2018...satellite tracking post-nesting turtles near

Canaveral shoals & sand mining sites



Current KSC efforts are maintaining dark skies while performing Space operations and launch missions.

KSC Dark Sky Initiative: "See the stars" Concept



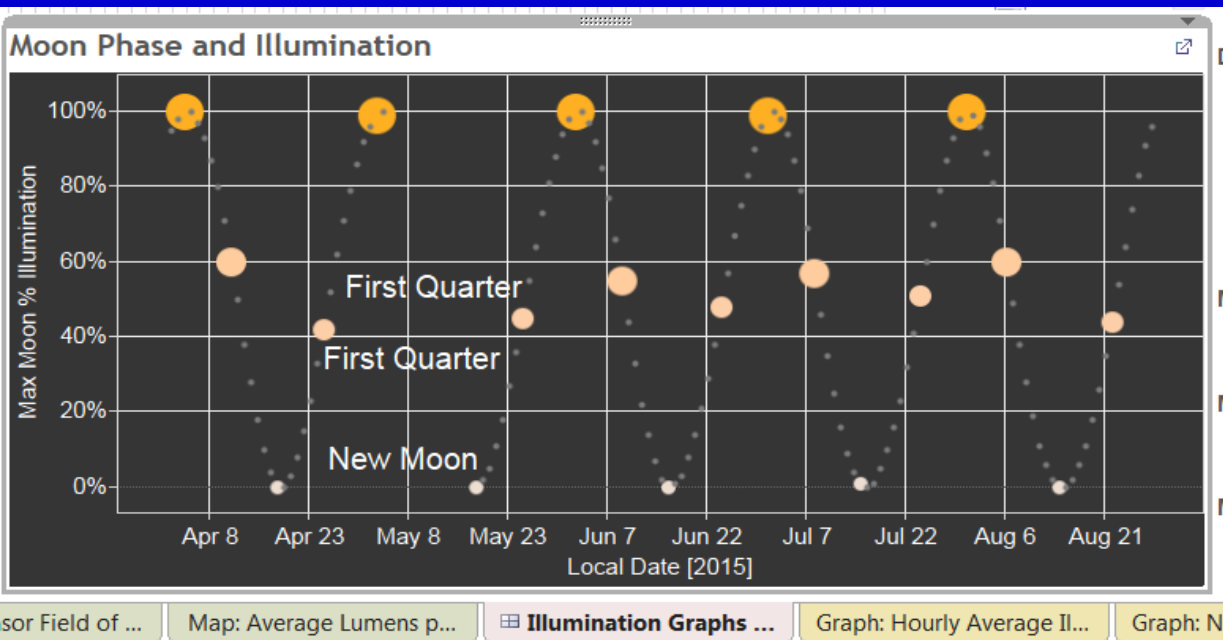
Photo by Tim Kozusko, 2008

- Proper lighting benefits the environment, ecology, and the safety of workforce
- When light is used only where and when it is needed without jeopardizing safety and mission
- Reduction in lighting that's been scientifically identified as disruptive to life cycles, movement, and behavior of nocturnal and diurnal species
- Collaboration with multiple stakeholders to monitor & improve sky darkness
- Unihedron Sky Quality instruments facilitate monitoring for safety & energy efficiency goals in construction designs KSC-wide.



Current scientific data collection at KSC includes

- Comparative analyses of control site(s) and industrial and urban skyglow
- Atmospheric influence on light diffusion
- Changes in illumination during different moon phases



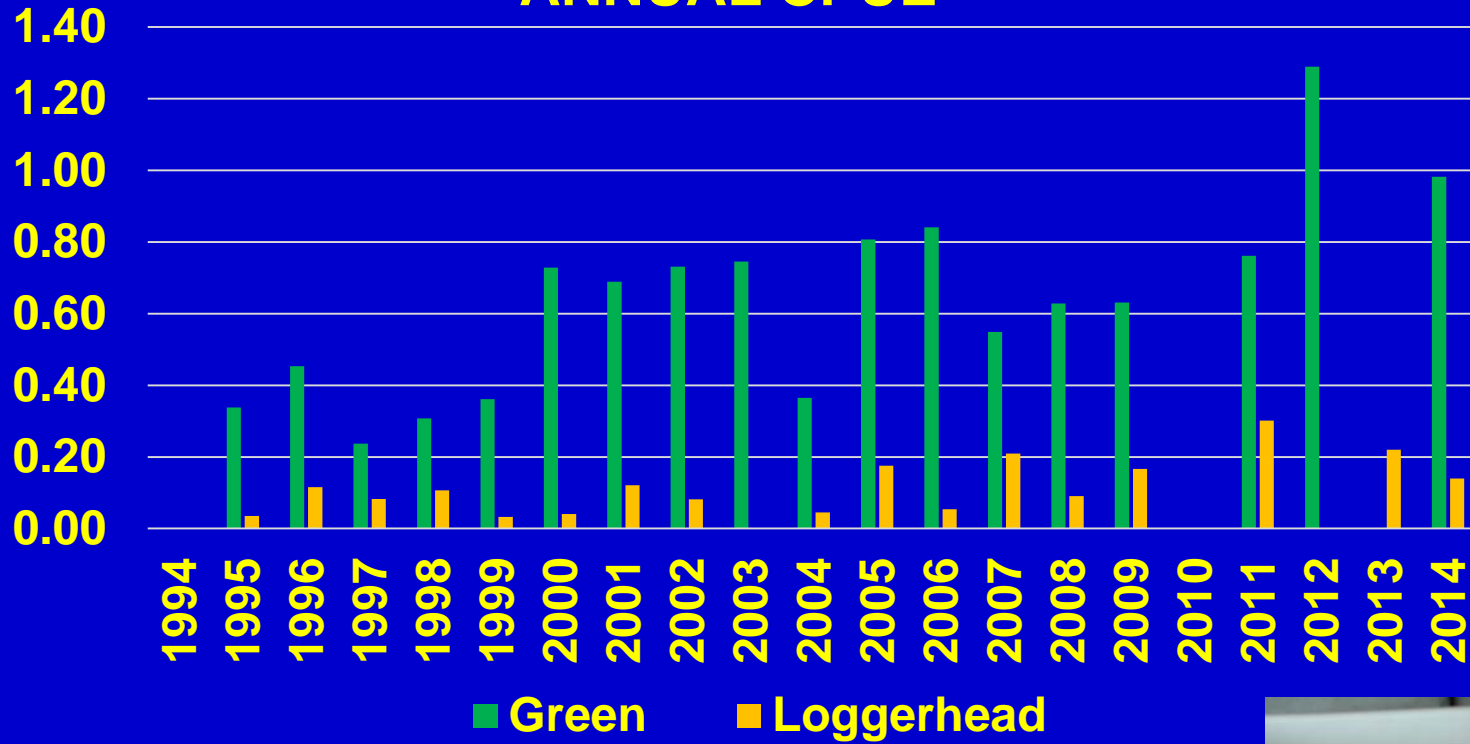
Relative Abundance & Distribution of Marine Turtles Inhabiting Mosquito Lagoon 1995- present



Conducted under NMFS permits (#1214, 942, 14655) and FMTP (#114).

Provancha, Cancro, Scheidt, Mota, Holloway-adkins, Lowers, Reyier

ANNUAL CPUE



Cold Stun Response -January 2010

Over 2000 sea turtles stunned in KSC waters



Most survived due to collaborative actions of KSC, regulatory partners, and agencies



Photo by Tim Kozusko



Ocean release due to cold temperatures in river

Some river releases after rehabilitation



60 sonic (NASA) & 3 satellite (UF) transmitters to track survival

2010 - Translocation of Gulf of Mexico Sea Turtle Nests Incubated at KSC and released at the Atlantic Coast - Deep Water Horizon Oil Spill





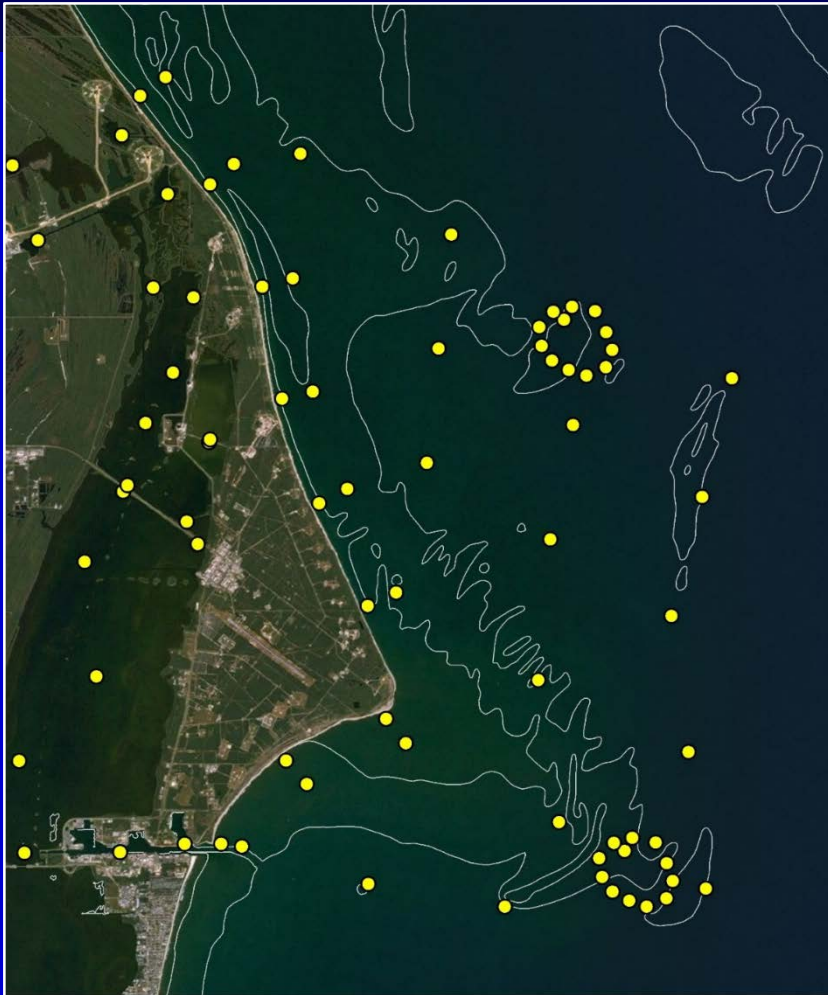
Transport & Incubate



RELEASE



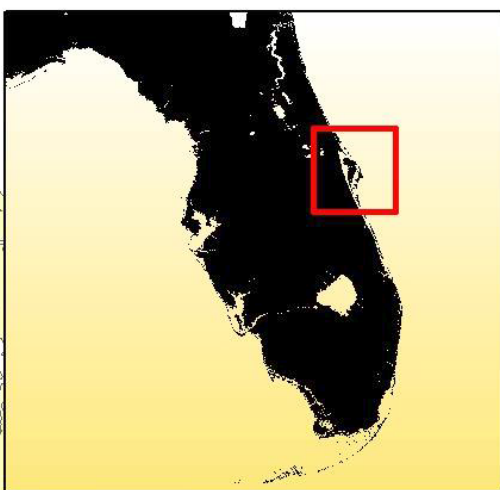
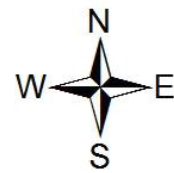
Quantify Inter-nesting Site Fidelity of Sea Turtles at Canaveral Shoals- Sand Mining Areas



- Document effects of dredging and shoreline nourishment on nearshore fish and turtles
- Relationship of biological data and future launch impact assessments
- Enhance NAVY/BOEM/NASA/USAF Consultations & Permitting
- Help guide species-specific management policy

BOEM/NAVY

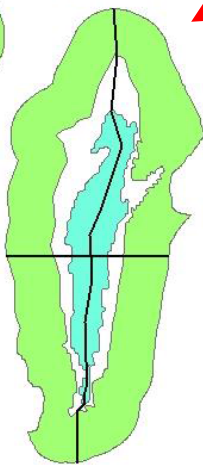
Canaveral as a Major Study Site



Chester Shoals

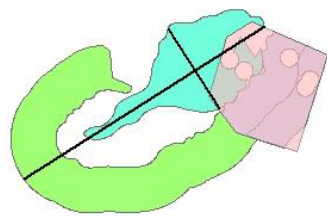


Bull Shoals

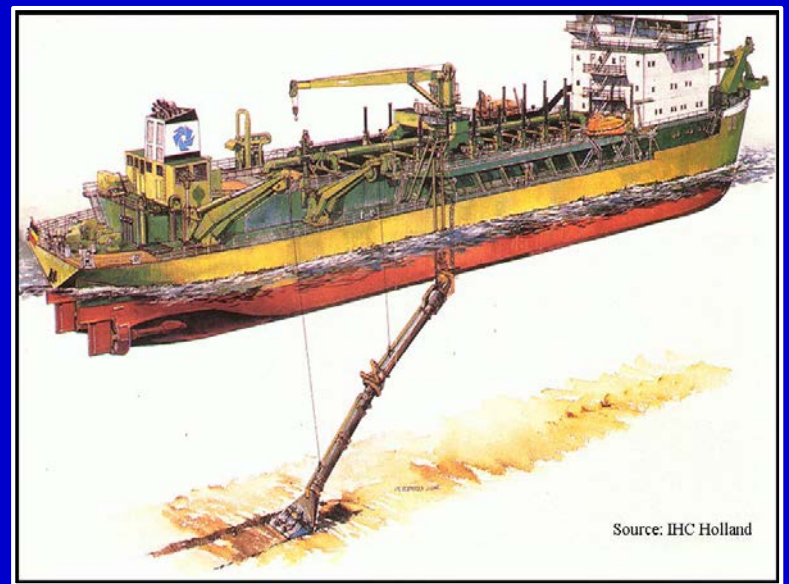


Reference Shoals

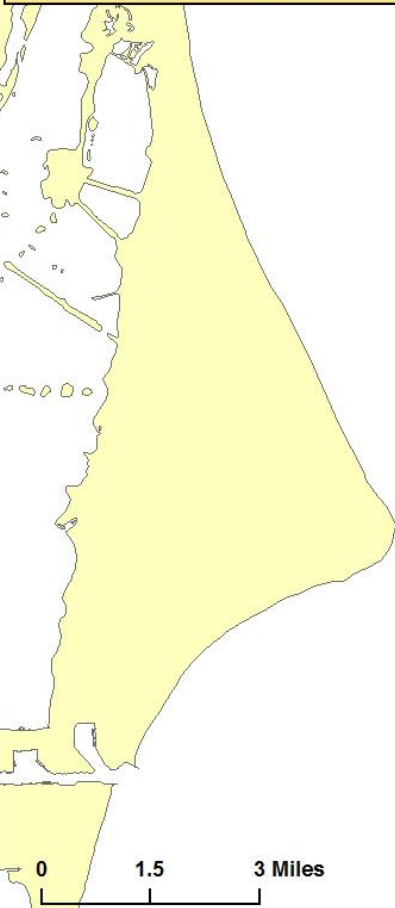
Canaveral Shoals II



Dredged Shoal



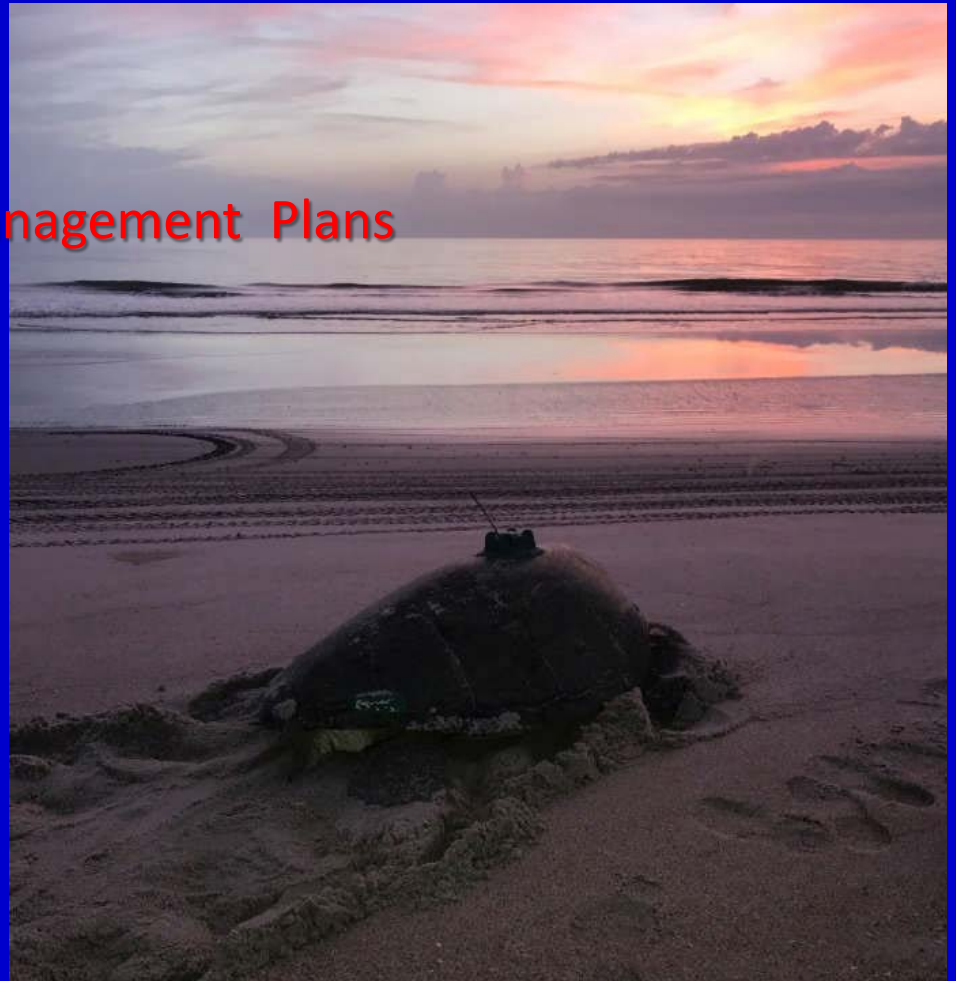
Source: IHC Holland



Recognizing that Canaveral is within the bounds of the largest nesting population of Loggerhead sea turtles in the Western hemisphere & a significant and growing population of Green turtles-

These data will support mandates for BOEM/NAVY/NASA/USAF/

- Endangered Species Act
- NEPA compliance
- Agency Natural Resource Management Plans



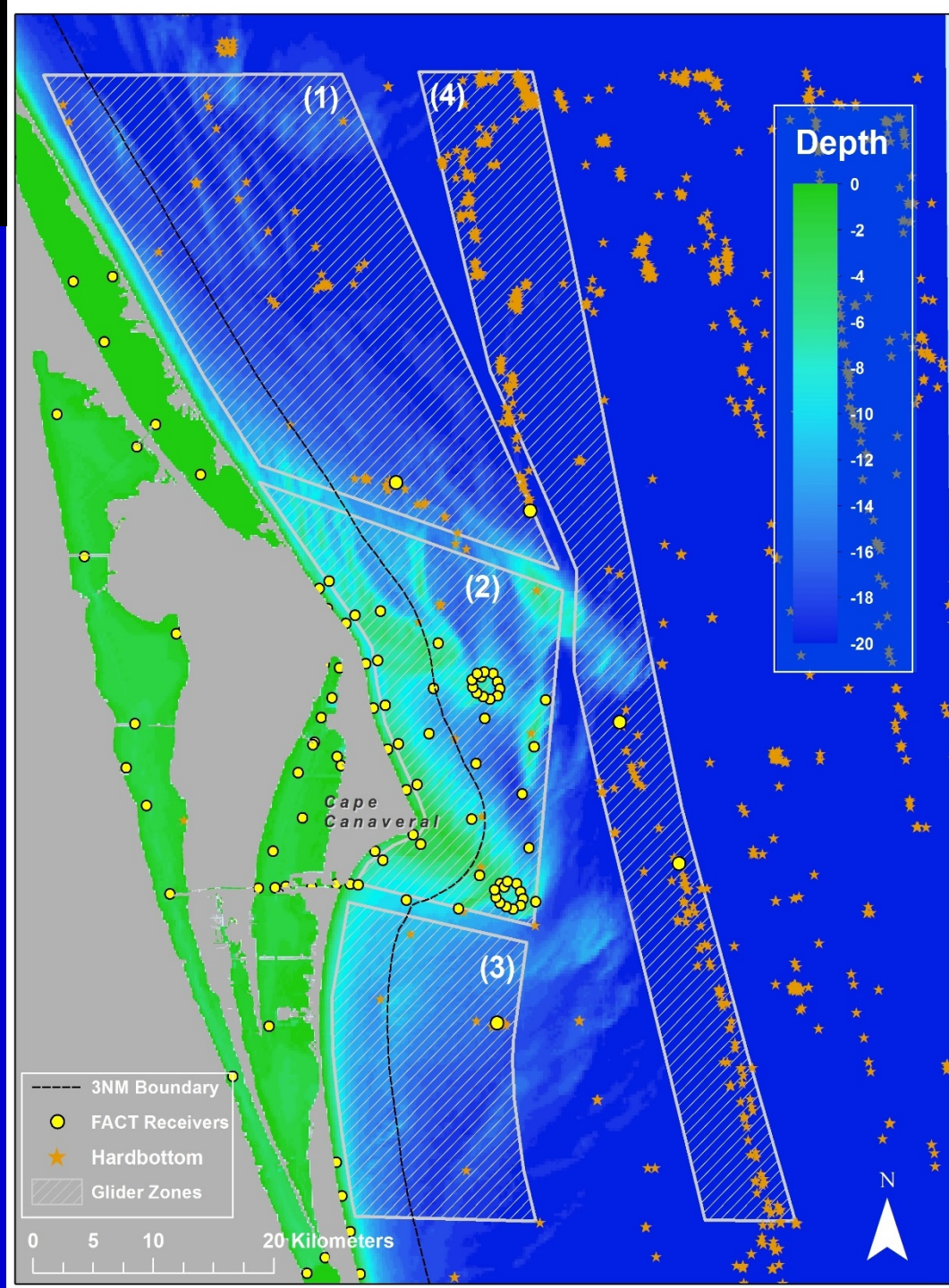
Liquid Robotics Wave Glider Automated Surface Vessel (ASV)



- Powered by waves & solar
- Multi-month missions
- Customized payloads
- Pre-defined transects
- Piloted via web browser

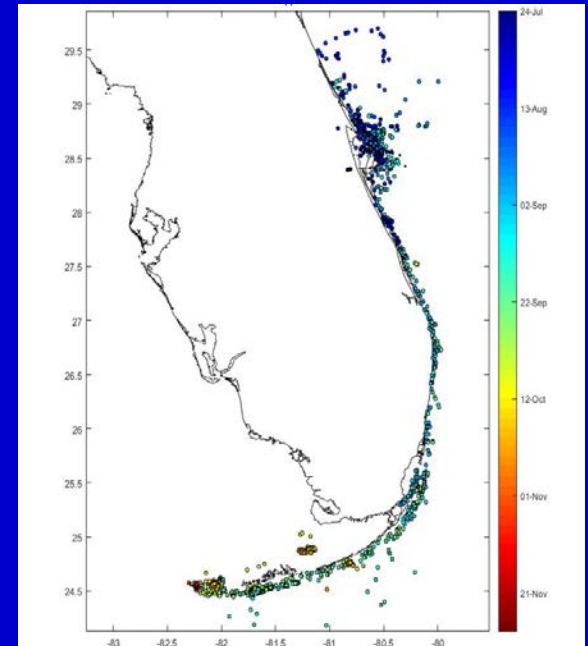
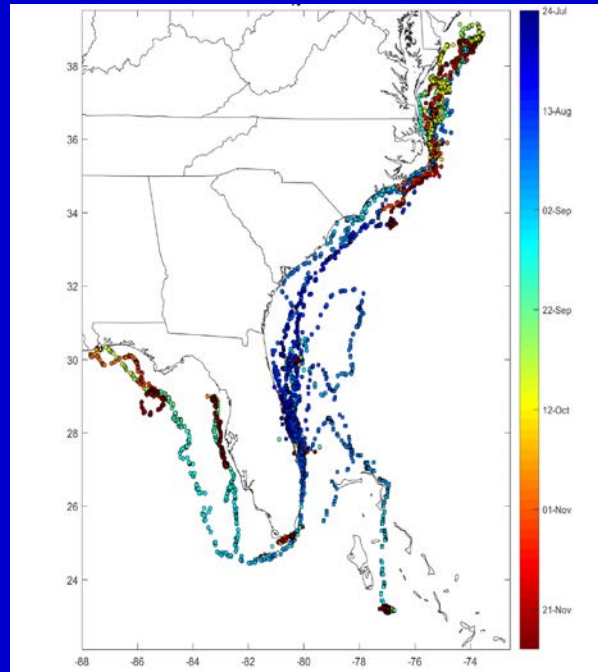
Wave Glider - Science Payload

- Mobile acoustic receiver
- Passive acoustic module
- Temperature sensor
- Dissolved O₂ sensor
- Chlorophyll sensor
- Turbidity sensor
- Wave height sensor



Science Objectives

- Quantify inter-nesting and post-nesting site fidelity at Canaveral shoals
- Interrogate differences in tag data for each individual
 - Acoustic network data (FACT array)
 - Satellite data vs fixed array data vs Wave Glider surveys



KSC continues to perform a strong stewardship role. Launching rockets, fly missions, and maintain a great nesting beach for turtles.



