Investigating the Linkages Between Mid-Shelf Petroleum Platforms and Pelagic Fishes Using Ultrasonic Telemetry

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Background

- Platforms act as artificial habitat
  - Protection from predation
  - Visual attractant for pelagic fishes
  - Enhanced foraging opportunities
- *Caranx crysos* (Blue runner) is one of the most common pelagic fishes around platforms

Blue Runner (*Caranx crysos*)

- Carangidae family
- Fast growing species reaches 75% of its maximum size in 3–4 years
- Largest recorded individual is 721 mm TL
- Feed in schools at surface during day
- Prey
  - Smaller fish
  - Zooplankton

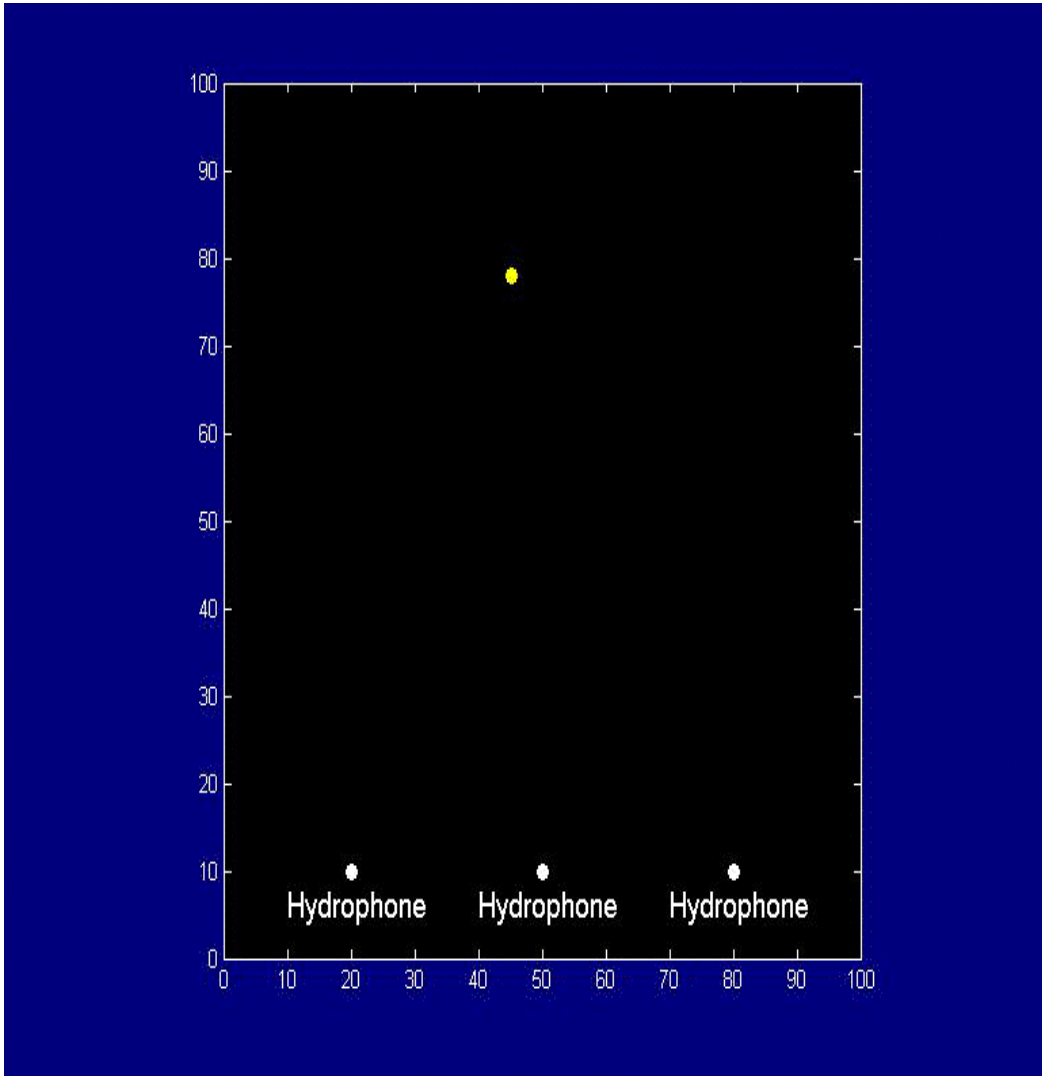
- Preyed on by tuna and other large fish

Blue Runner (*Caranx crysos*)

- Larvae feed primarily on copepods, amphipods and chaetognaths
- Adults feed on zooplankton, cephalopods, and larval fish
- Feed both day and night, with feeding peaking in predawn and early morning hours

Acoustic Localization

- Fixed hydrophones
- Tagged fish
- Position determined by computing difference in arrival times of signal at hydrophones



Objectives

- Why are there so many pelagic fishes around offshore platforms?
  - Investigate side fidelity/home range of pelagic fishes around petroleum platforms
  - Investigate the schooling behavior of blue runner
  - Investigate the nocturnal distribution/behavior of blue runner
  - Trophic linkages between blue runner and platforms
- Understand why there are so many blue runner at offshore platforms

Home Range

- "... that area traversed by the individual in its normal activities of food gathering, mating, and caring for young. Occasional forays outside the area, perhaps, exploratory in nature, should not be considered part of the home range." (Burt 1943)
- Core range – Area encompassing range where individual spent 50% of time
- 95% range – Based on 0.05 statistical parameter, where individual spends 95% of its time, with only occasional forays outside area

Home Range

- Advantages
  - Efficiency of feeding sites
  - Protection of favorable breeding sites
  - Predator refugia
- Disadvantages
  - Possible depletion of food resources
  - Forgoing opportunity to discover higher quality habitats

Schooling

- About 25% of all fish species school at some point in their life cycle
- Diel pattern of schooling during day and scattering at night typical of schooling species
- Advantages
  - Improved food foraging
  - Reduced risk of predation
  - Increased ability to hunt cooperatively
  - Improved hydrodynamics

Nocturnal Distribution

- Prey items exhibit diel vertical migration
- Downwelling light field provided at manned platforms
- Provides increased ability to forage visually at night

Study Location

- South Timablier 151 (ST151)
- 50km South of Port Fourchon
- 35 km^2 Area
- Water depth 30–42m

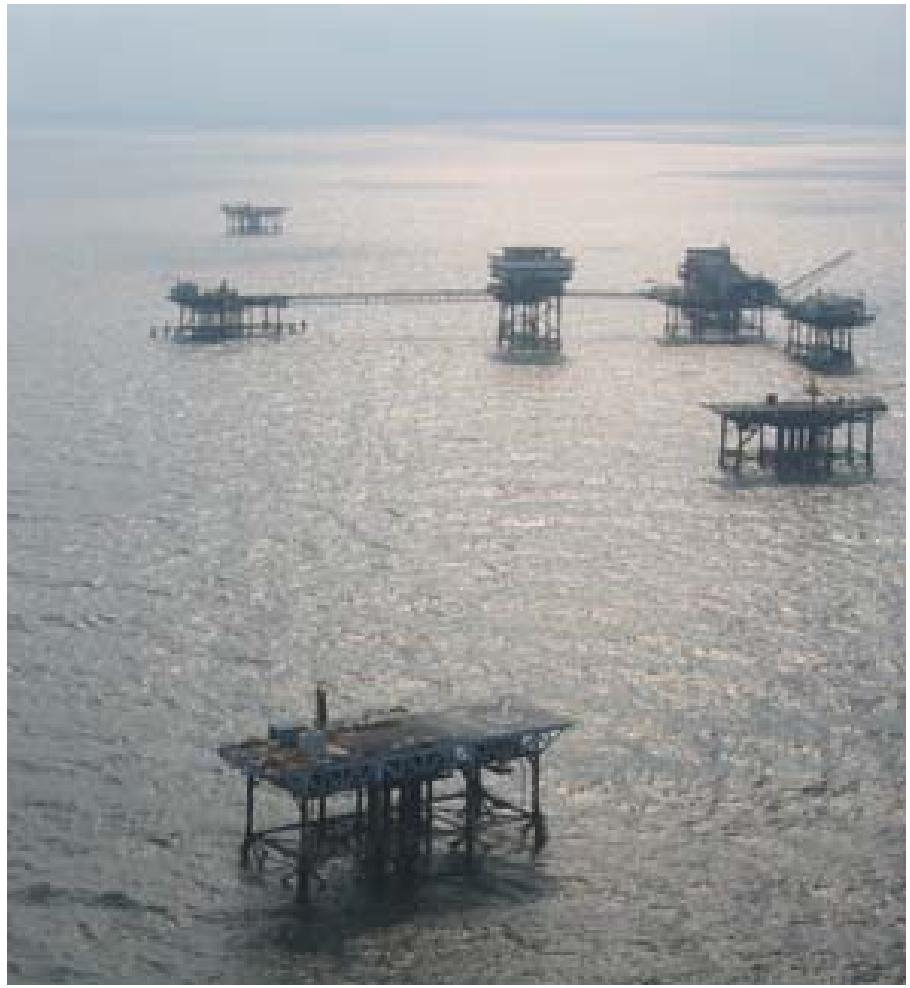
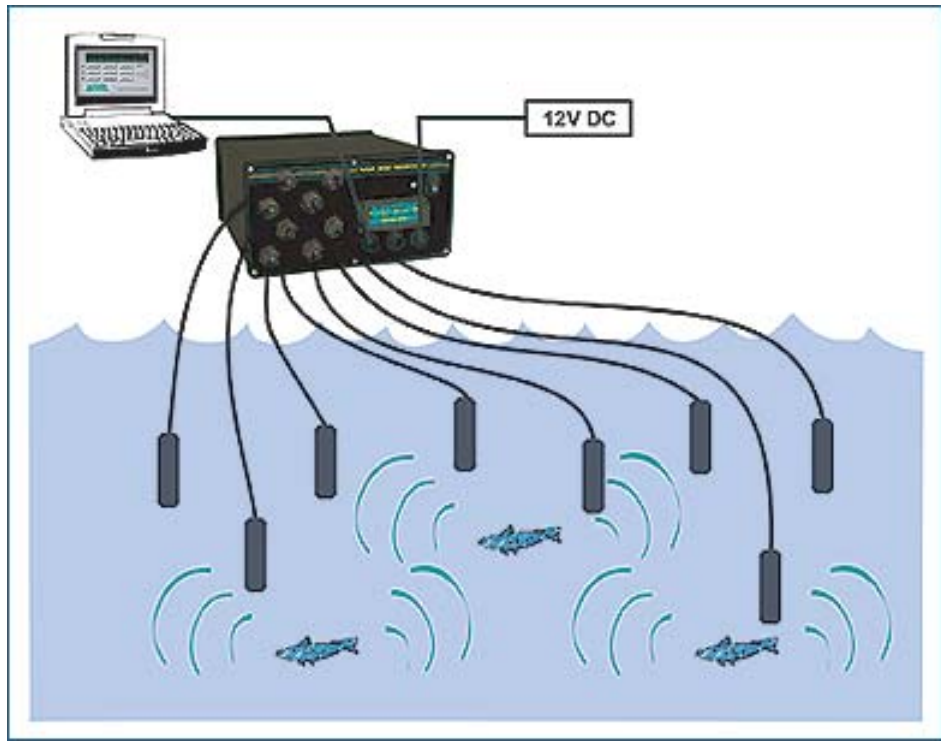


Photo by S. Keenan

MAP 600 System

- Lotek Wireless
- 8 fixed hydrophones
- Central receiver
- Download data to laptop

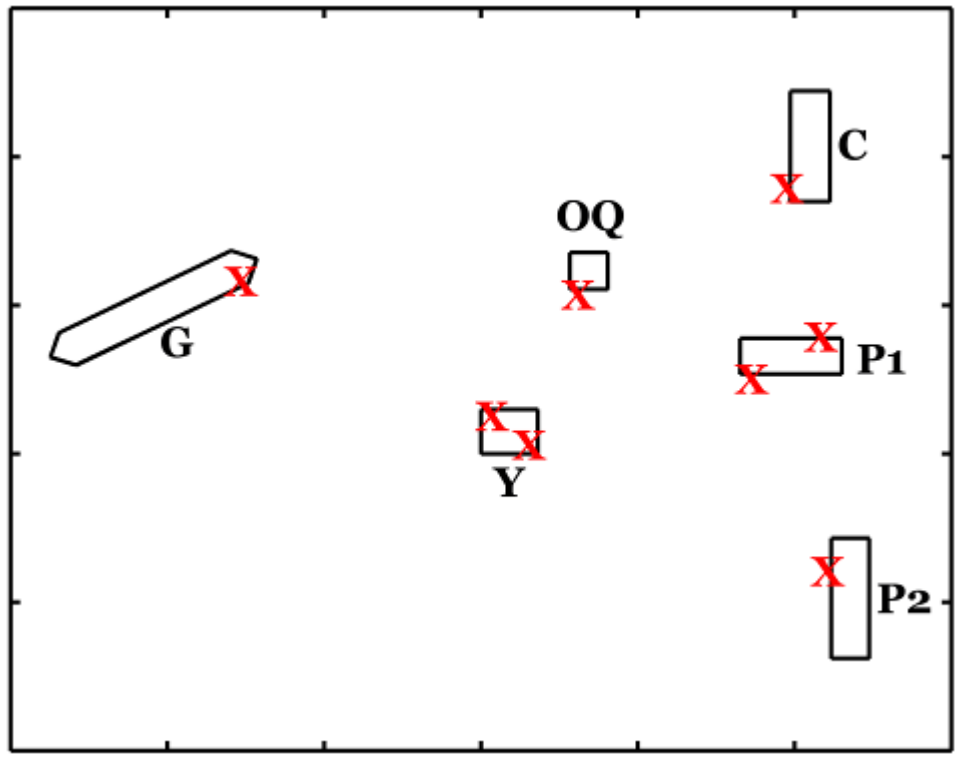


http://www.lotek.com/map_600.htm

http://www.lotek.com/hp.htm

2005 Hydrophone Placement

- Secured to legs of all six platforms
- ~10m below surface



2005 – Satellite Platforms

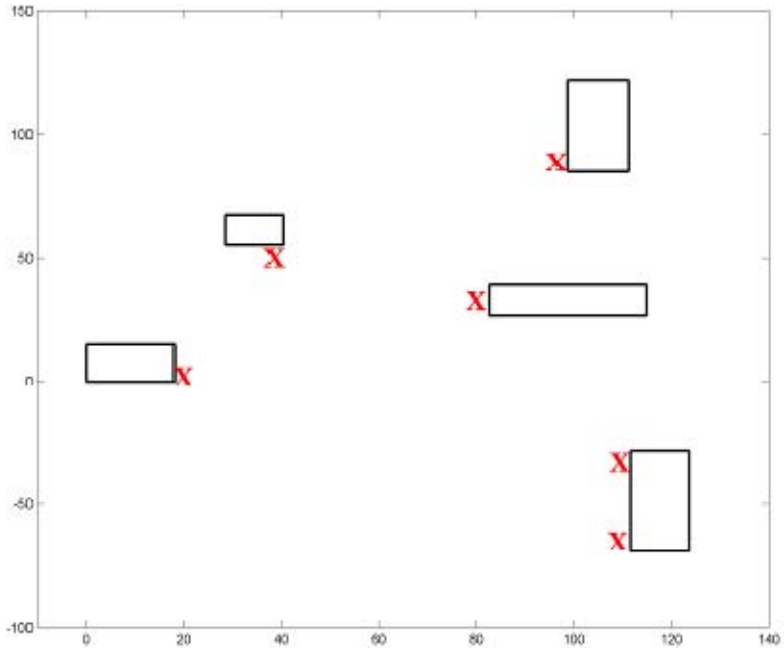
- Hydrophones on 3 satellite platforms
- Presence/absence
- Movement

Photo by S. Keenan

Effects of Hurricane Katrina

2006 Hydrophone Placement

- 7 hydrophones placed around the ST151 main complex



2006 Satellite Platforms

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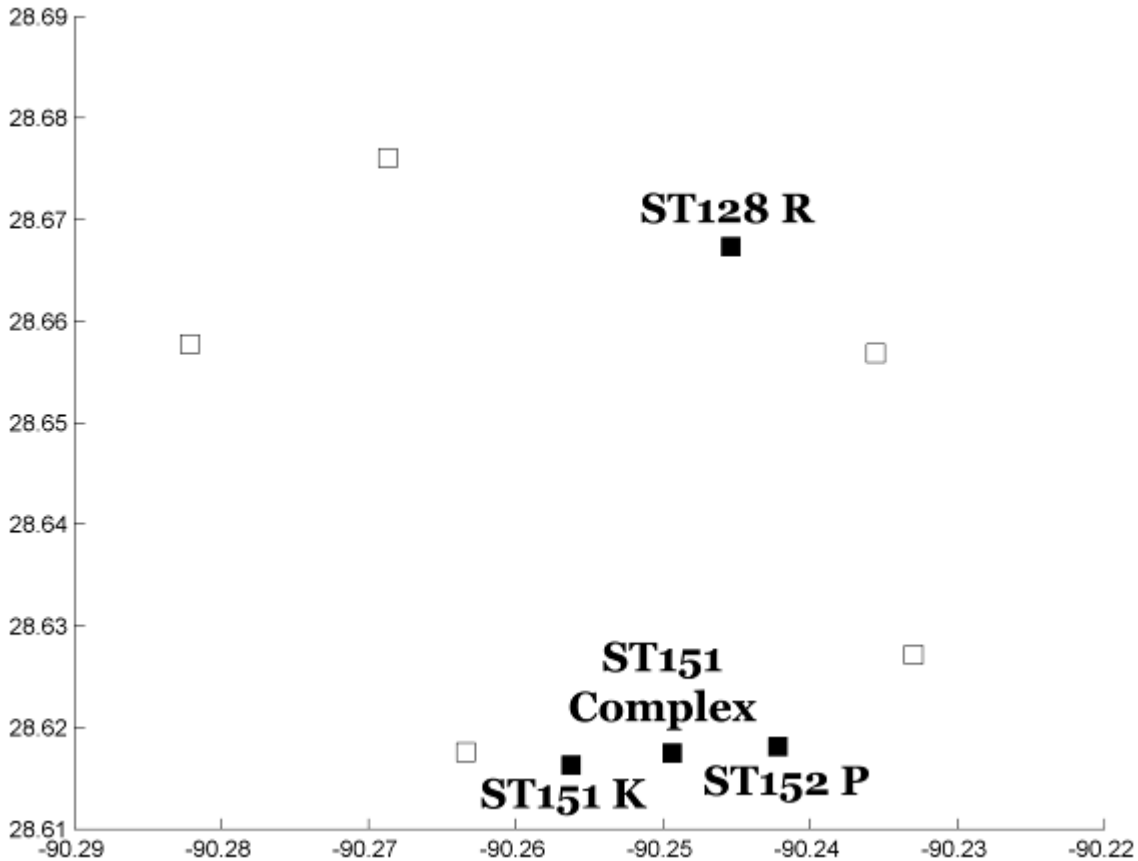
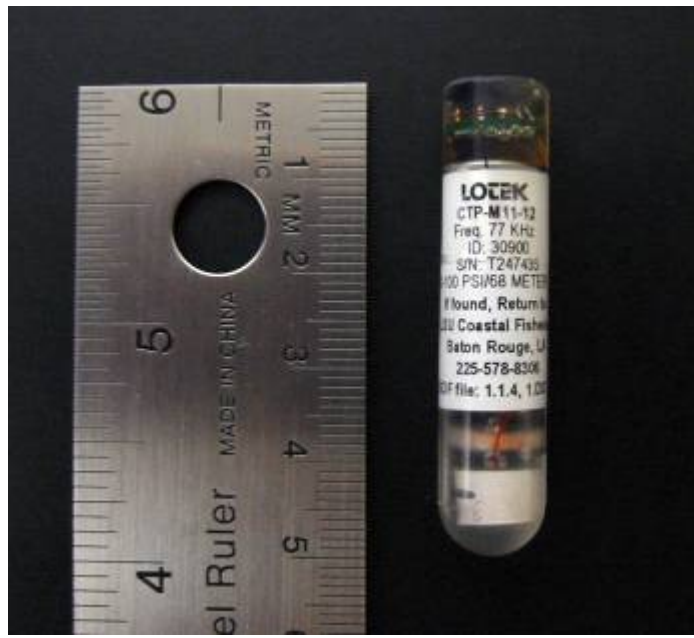


Acoustic tags

- Depth and Temperature sensing
- 2005
  - 46 blue runner tagged
  - 13 with 2-second ping rate
  - 33 with 4-second ping rate
- 2006
  - 19 blue runner tagged
  - All with 10 second ping rate



Fish Tagging

- Hook, line and lure
- MS-222
- Tag inserted in peritoneal cavity
- Given antibiotic
- Allowed to recover before release

Fish Tagging

- 2005

- 2006

Home Range Data Analysis

- Home Range (HR) calculated using ArcGIS 9.2 and the Home Range Extension
- Day/night differences tested with tw0-tailed paired t-test
- GLM used to test differences in area of HR for all fish
- Multivariate GLM used to compare daily HR area by individual and Julian date

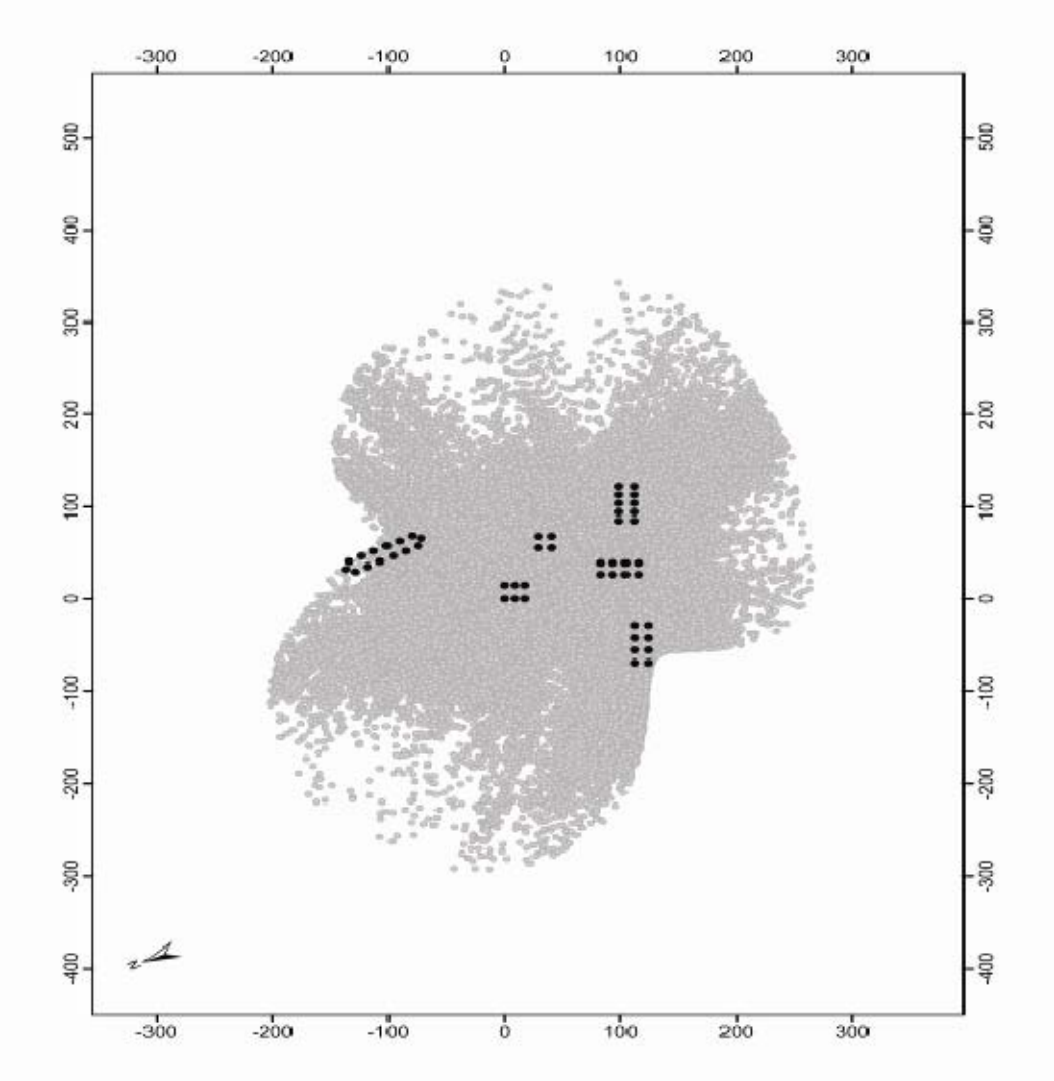
Schooling Data Analysis

- Euclidean distance between each fish calculated
- Maximum school size determined to be 36m
- Day/night schooling compared using two-tailed paired t-test
- Movement between schools tested using chi-square test
- Schooling location with respect to platforms tested using single factor ANOVA

Nocturnal Data Analysis

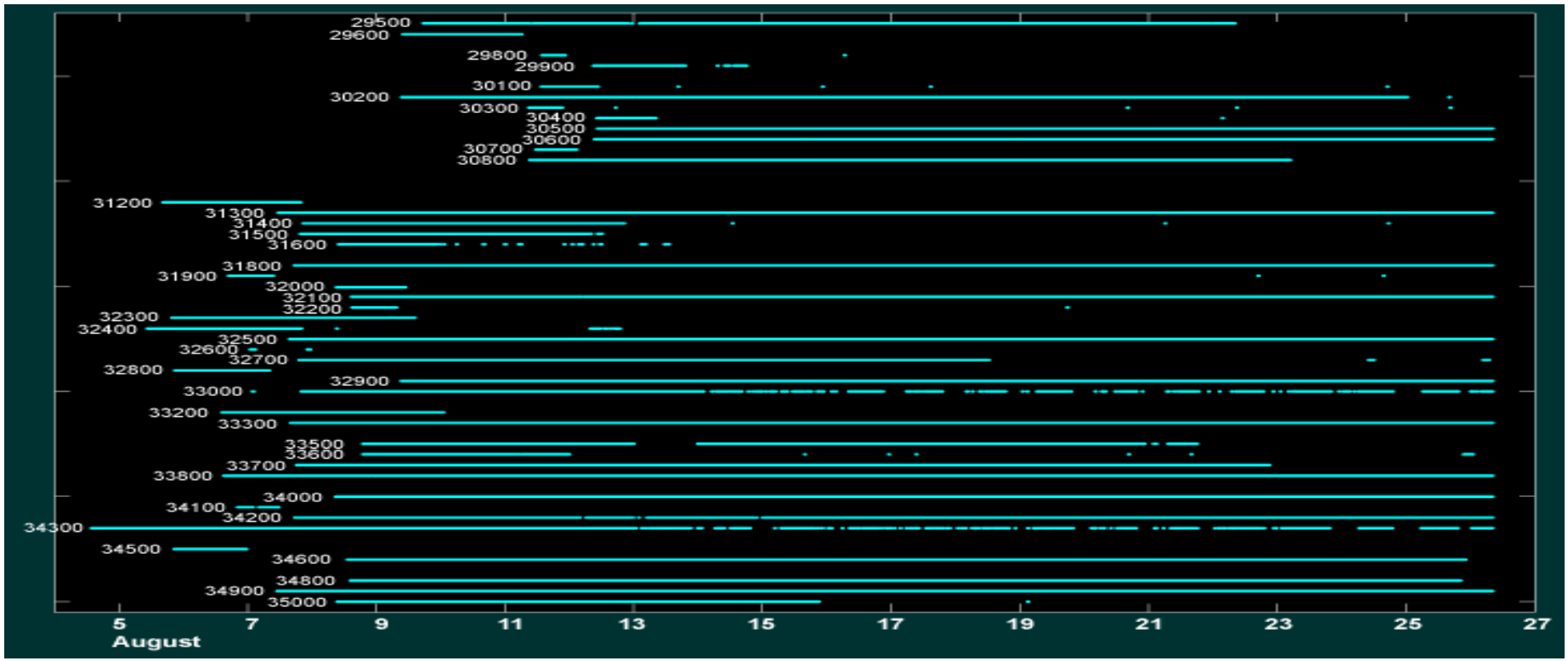
- Day/night depths compared using two-tailed paired t-test
- Single factor ANOVA used to test locations relative to platforms
- Nighttime swimming speed was investigated to determine if the fish were exhibiting passive or active foraging

Detection Envelope



Results

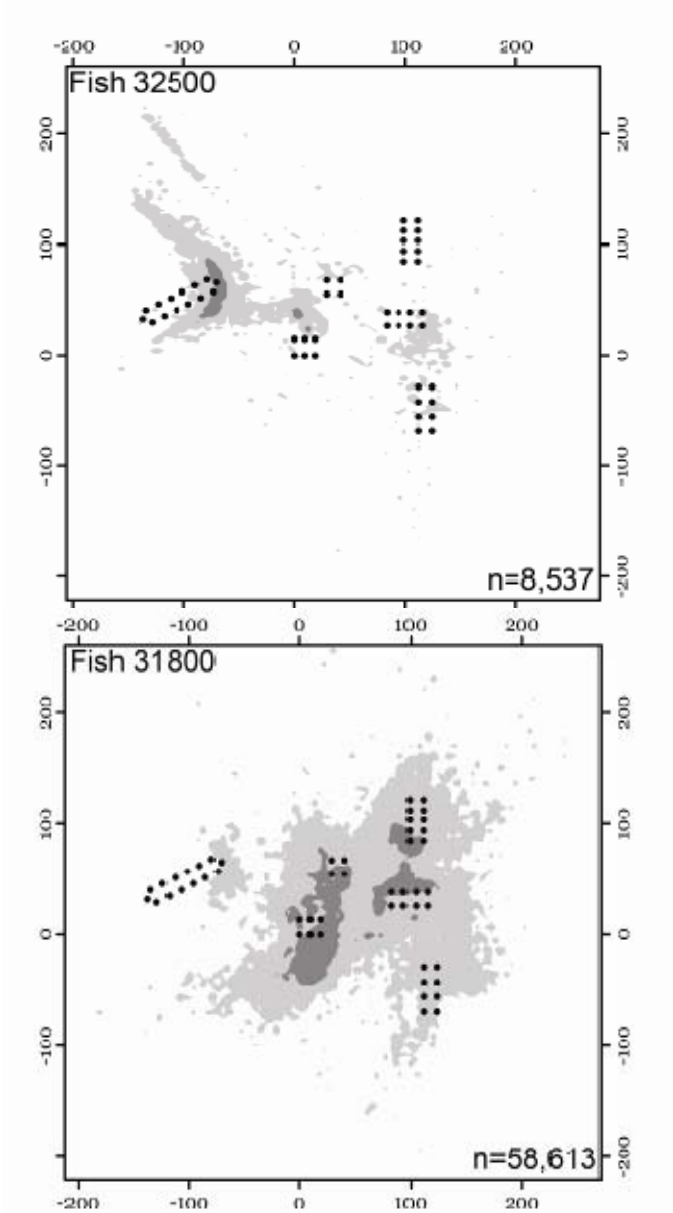
- 23 tagged fish tracked for at least 7 consecutive days in 2005



- 9 tagged fish tracked for at least 7 consecutive days in 2006

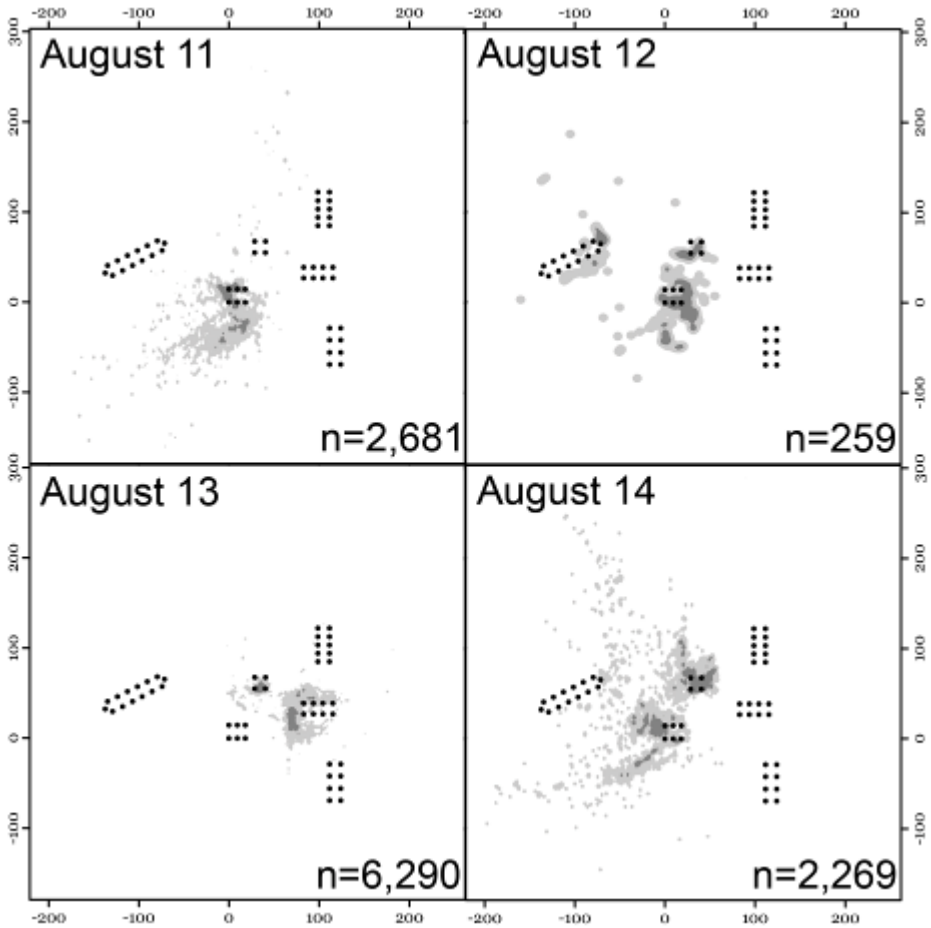
Home Range

- Overall range
  - Core – 653–5,307 m^2
  - Significant difference between core range and fish FL
  - 95% – 10,246–36,406 m^2
  - No significant difference between 95% range and FL



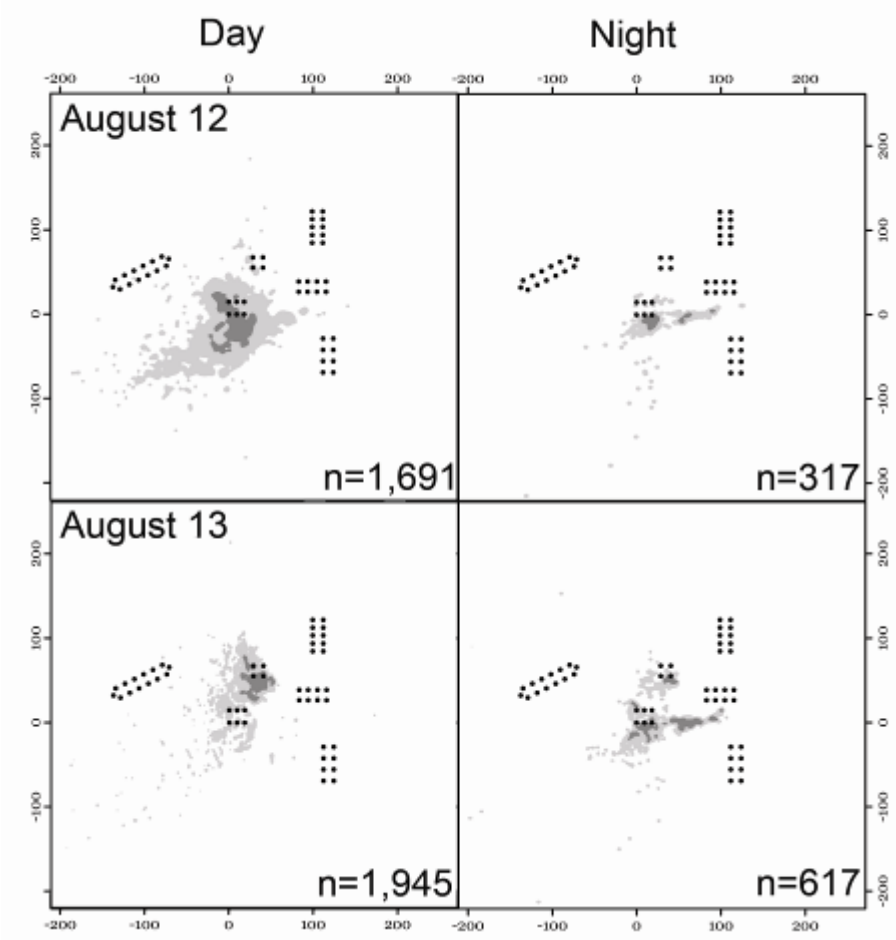
Home Range

- Daily Range
  - Core - 373 – 2,202 m^2
  - 95% - 3,082 – 14,333 m^2
  - Significant difference between 95% range and fish FL
  - Significant difference between the size of the core range and the 95% range and the Julian day



Home Range

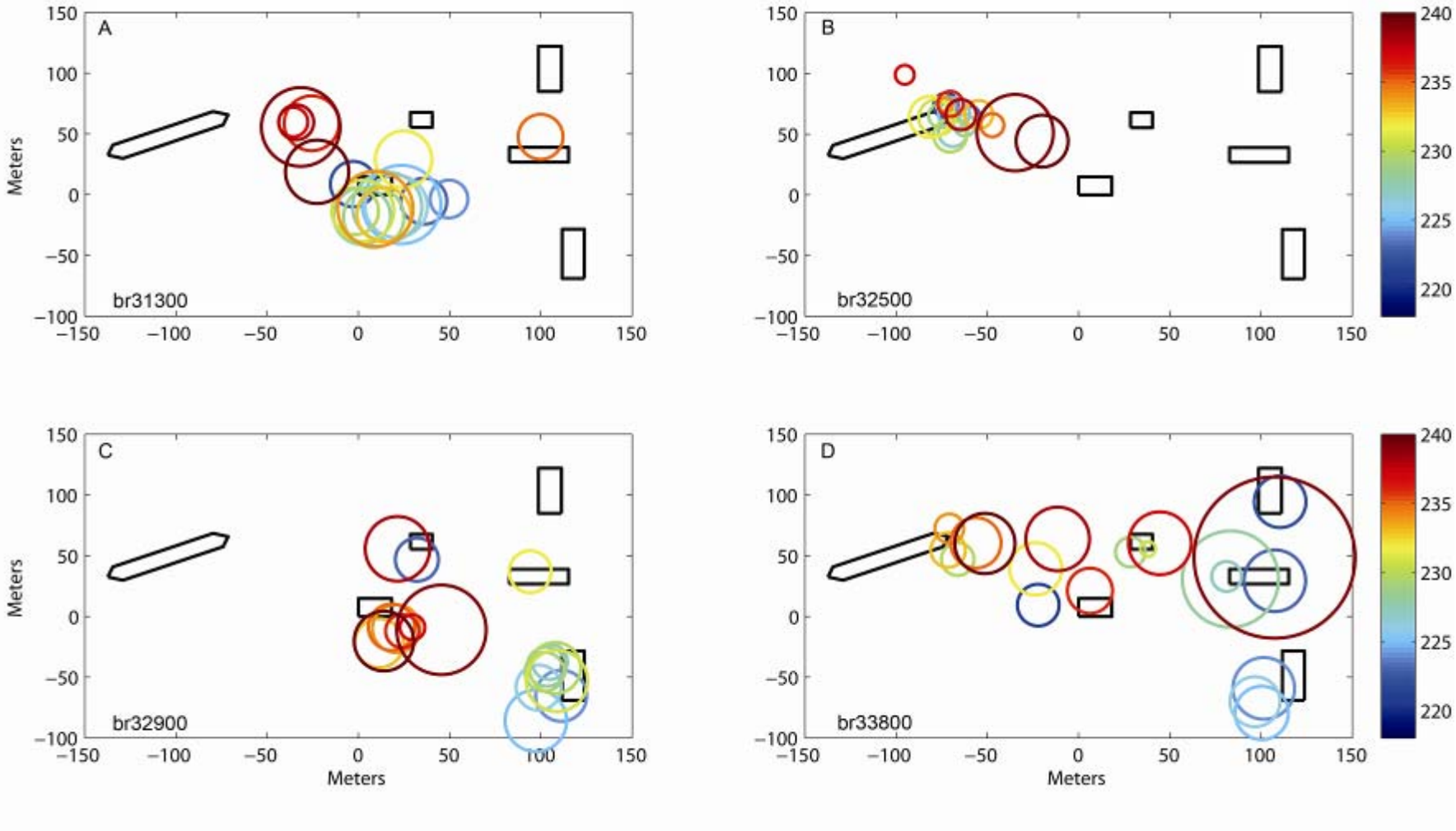
- Core and 95% home ranges were generally larger during the day and smaller at night
- Fish 34900 only fish to have a significantly larger daytime core range
- Fishes 30600 and 34900 only fishes to have a significantly larger daytime 95% range



Site Fidelity

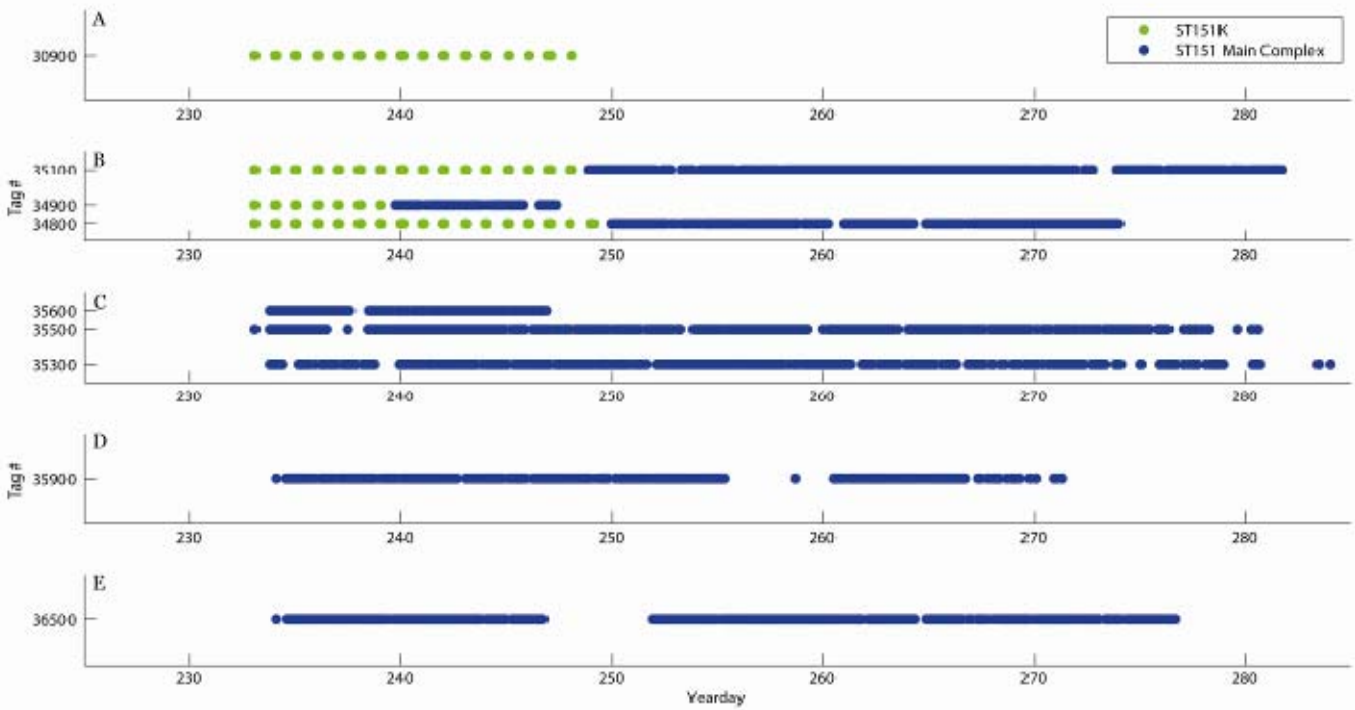
- Three general patterns
  - Restricted home range to one platform for 7 or more days (9 fish)
  - Restricted home range to one platform for 3–6 days (7 fish)
  - Changed the location of their home range day to day (3 fish)
- Different fish, each displaying high site fidelity, were not all collocated at the same part of the platform on the same days

Site Fidelity

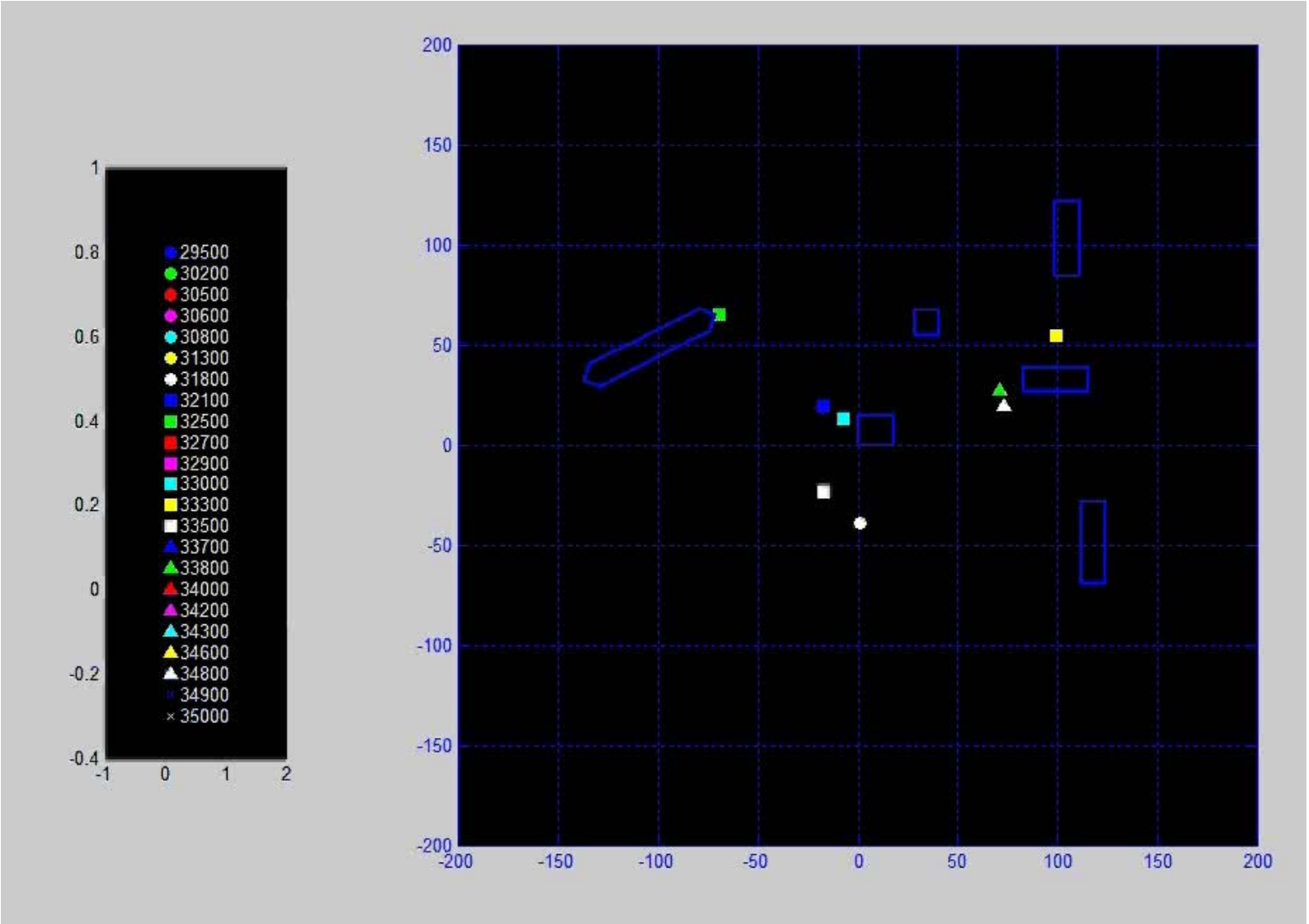


Broad-scale Movements

- Four fish released at ST151K
- Five fish released at ST151 Main Complex
- All but one fish remained and/or moved to the main complex

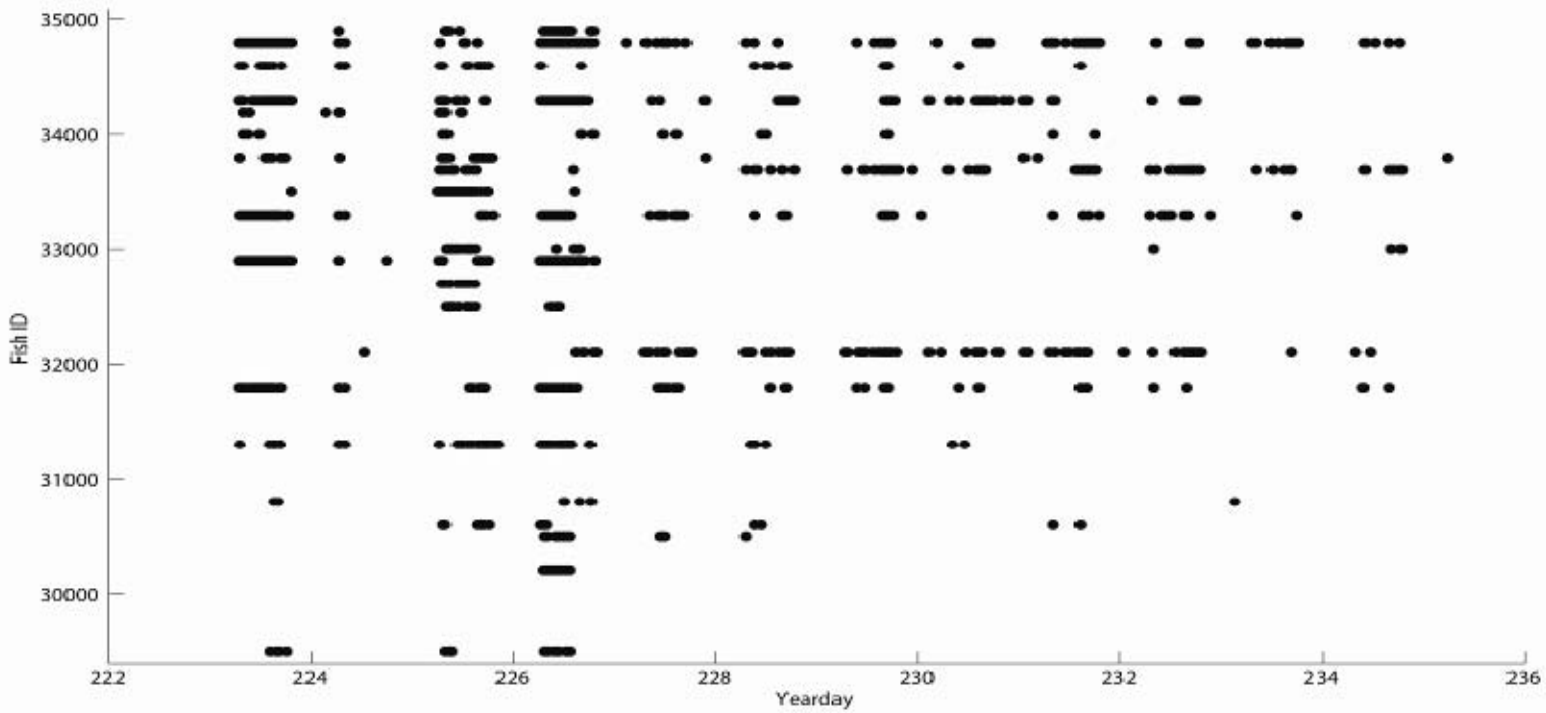


Schooling Distribution



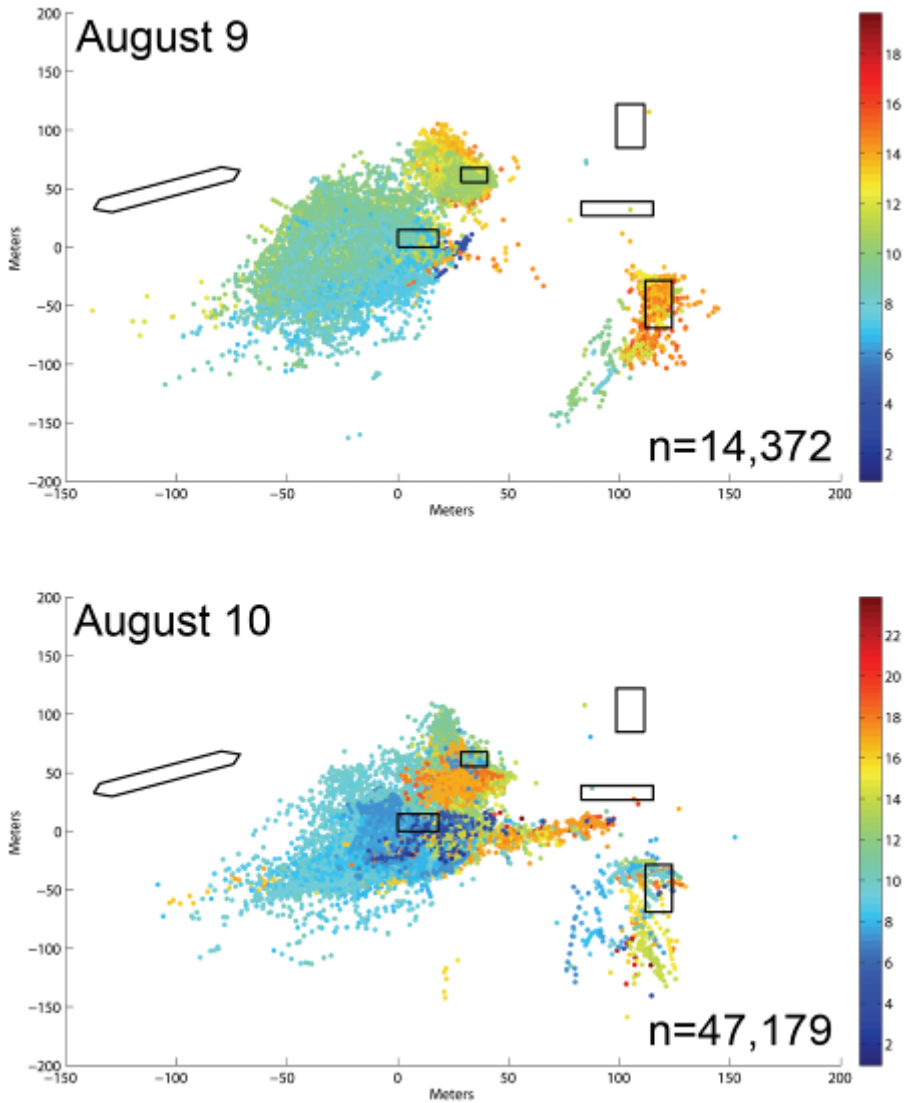
Schooling Results

- All fish found to school more often during day than at night
- Individual fish did move between schools, but showed a preference for schooling with particular fish



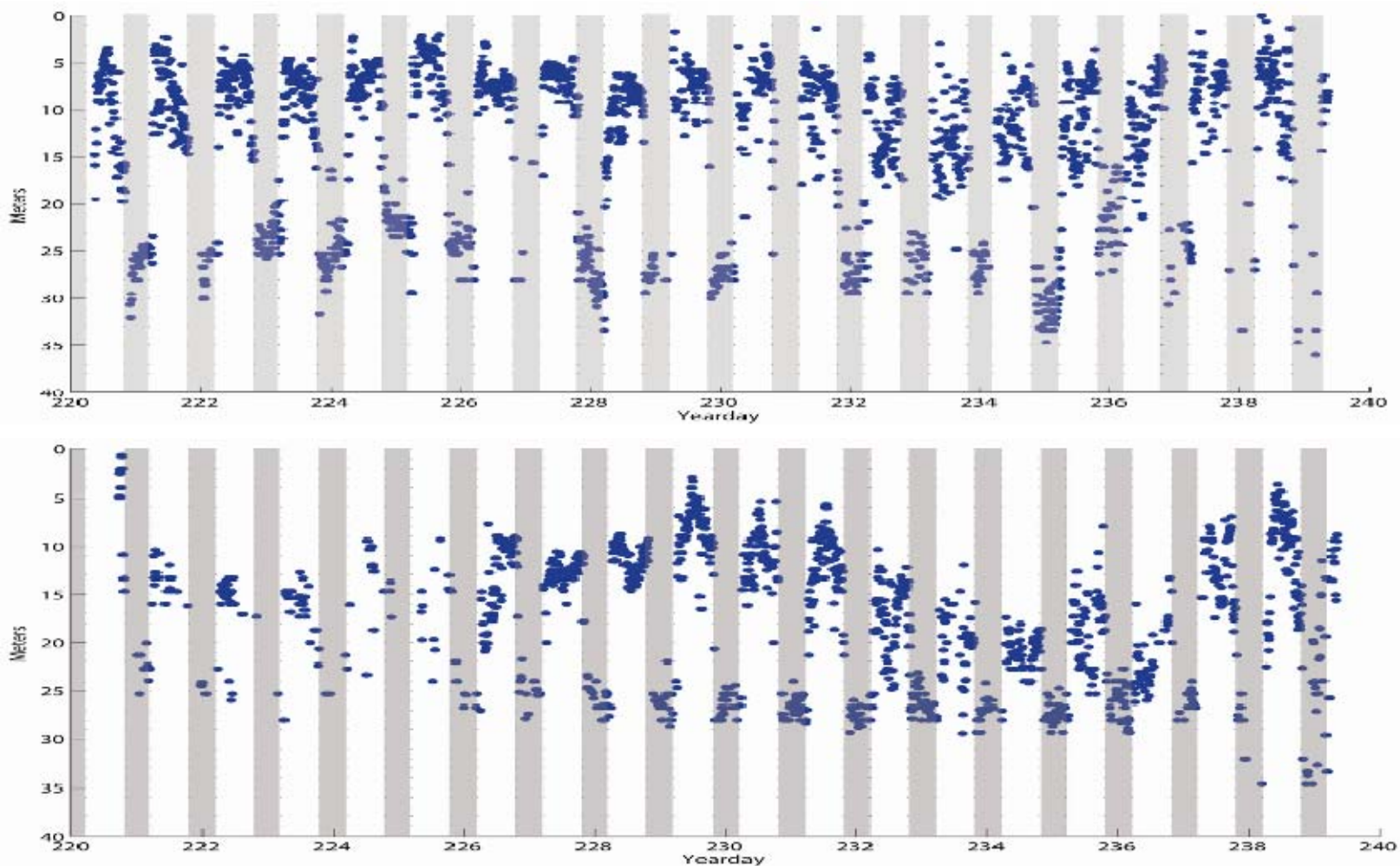
Schooling Location

- Significant difference between locations of schools in relation to the platforms

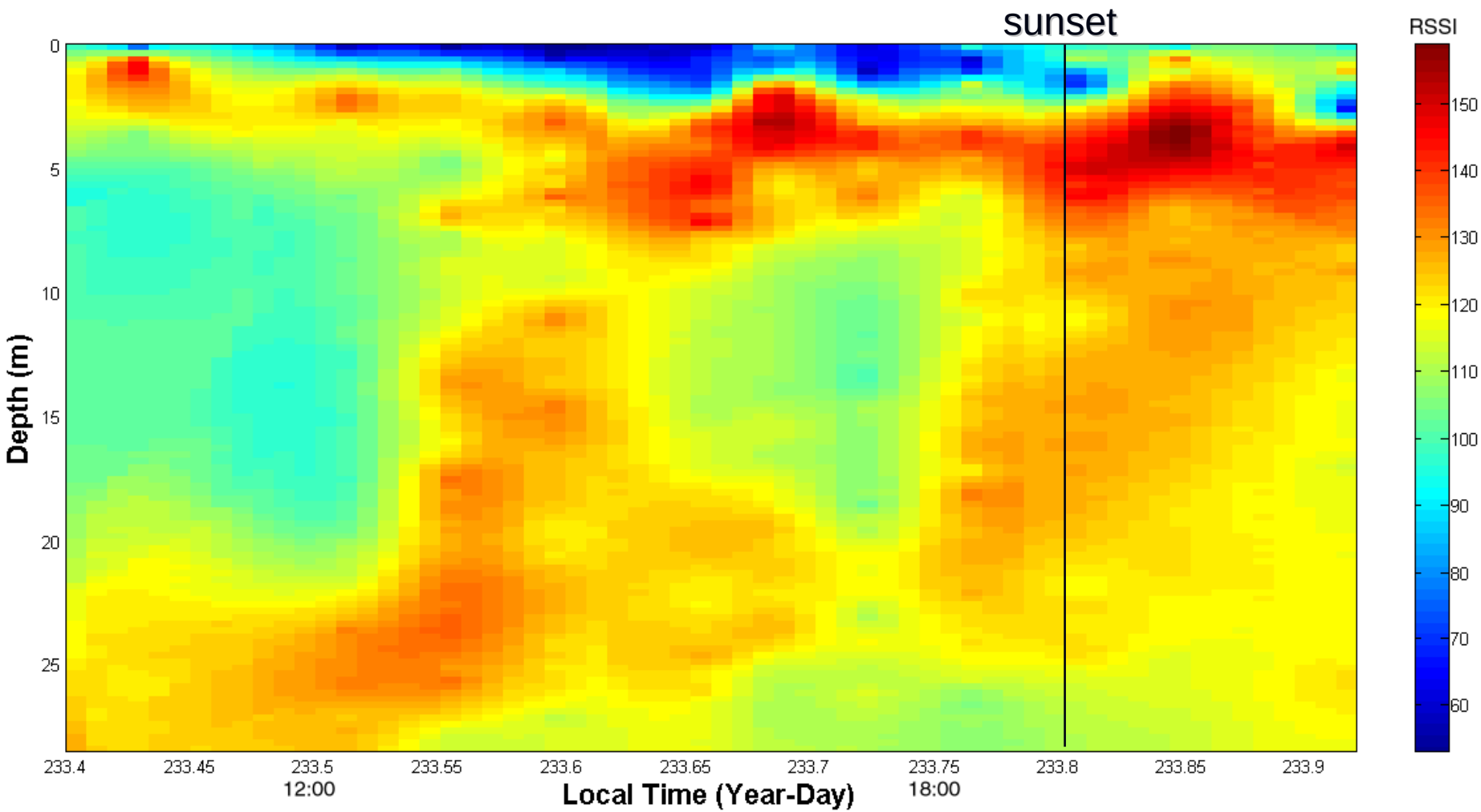


Vertical Distribution

- Significant difference between daytime and nighttime vertical distributions

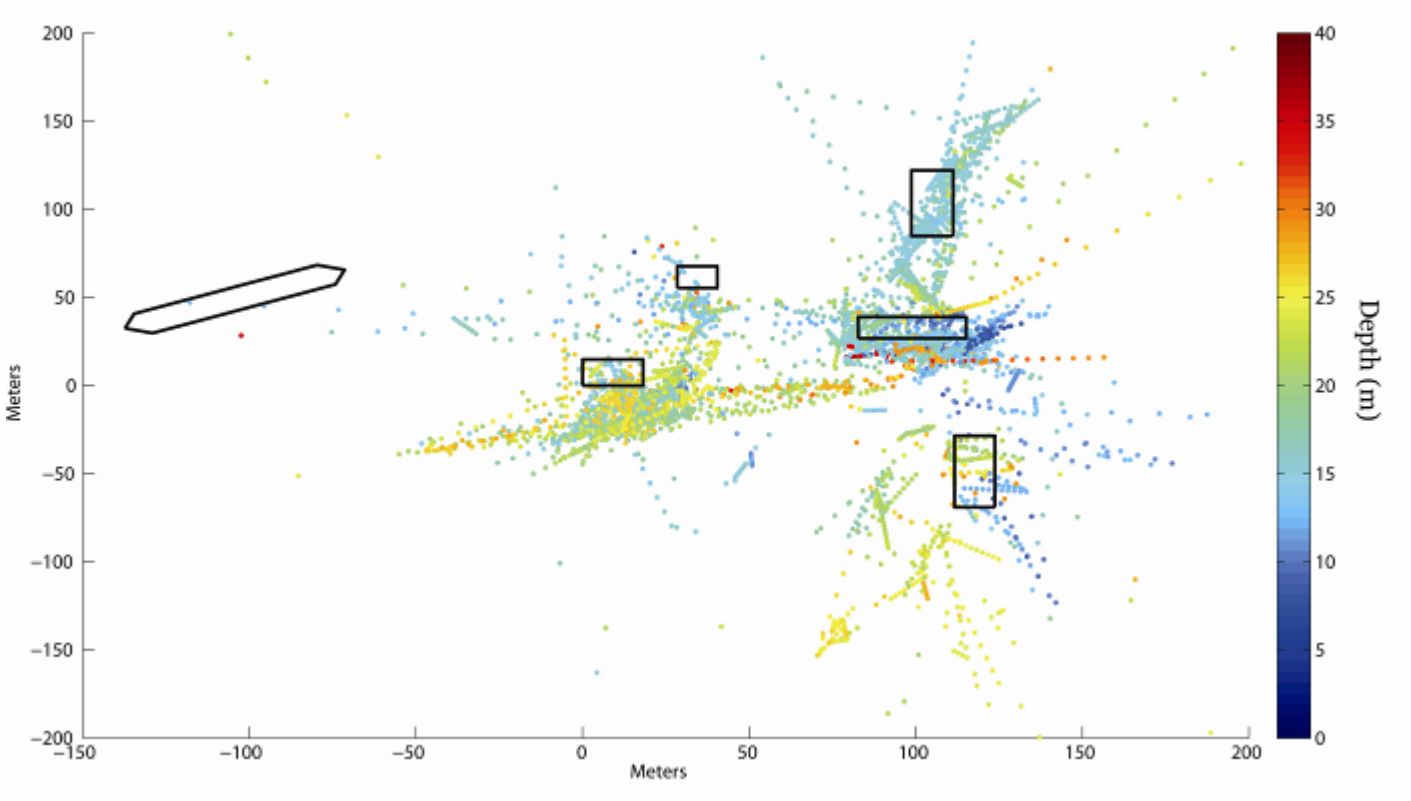


Daily Distribution of Backscatter at ST151



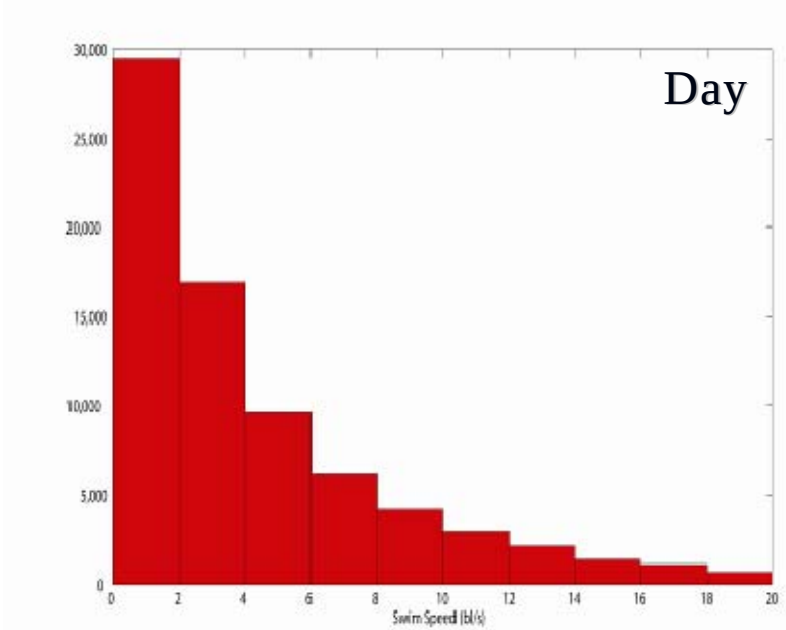
Nocturnal Distribution

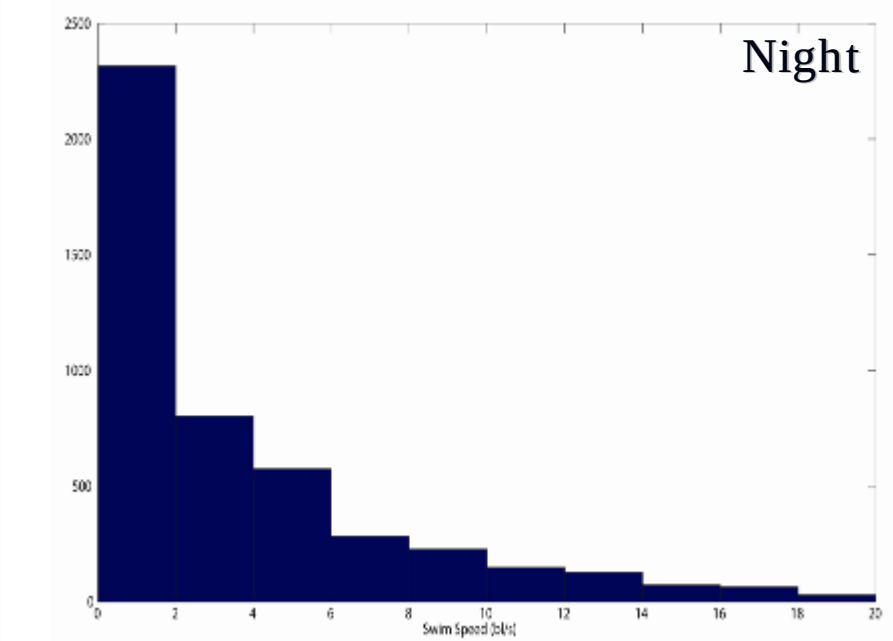
- No clear pattern with relation to distribution relative to the platform locations



Nocturnal Swimming Speeds

- Mean swimming speed ranged from 1.97 to 4.12 bl/s
- Fish most often found swimming at 0–2 bl/s





Conclusions

- Blue runner exhibit site fidelity and establish a home range near platforms
- Home range size larger during the day
- Tagged blue runner caught and/or released away from main complex returned to, and remained at, the main complex

Schooling Conclusions

- Blue runner found to school more during day than at night
- Individual blue runner move between schools
- Tended to school closer to some platforms than others

Nocturnal Conclusions

- Blue runner tended to remain at depth during the night and nearer the surface during the day
- No clear pattern of nocturnal distribution relative to the platforms
- Exhibited passive foraging behavior based on swimming speeds

Challenges – 2005

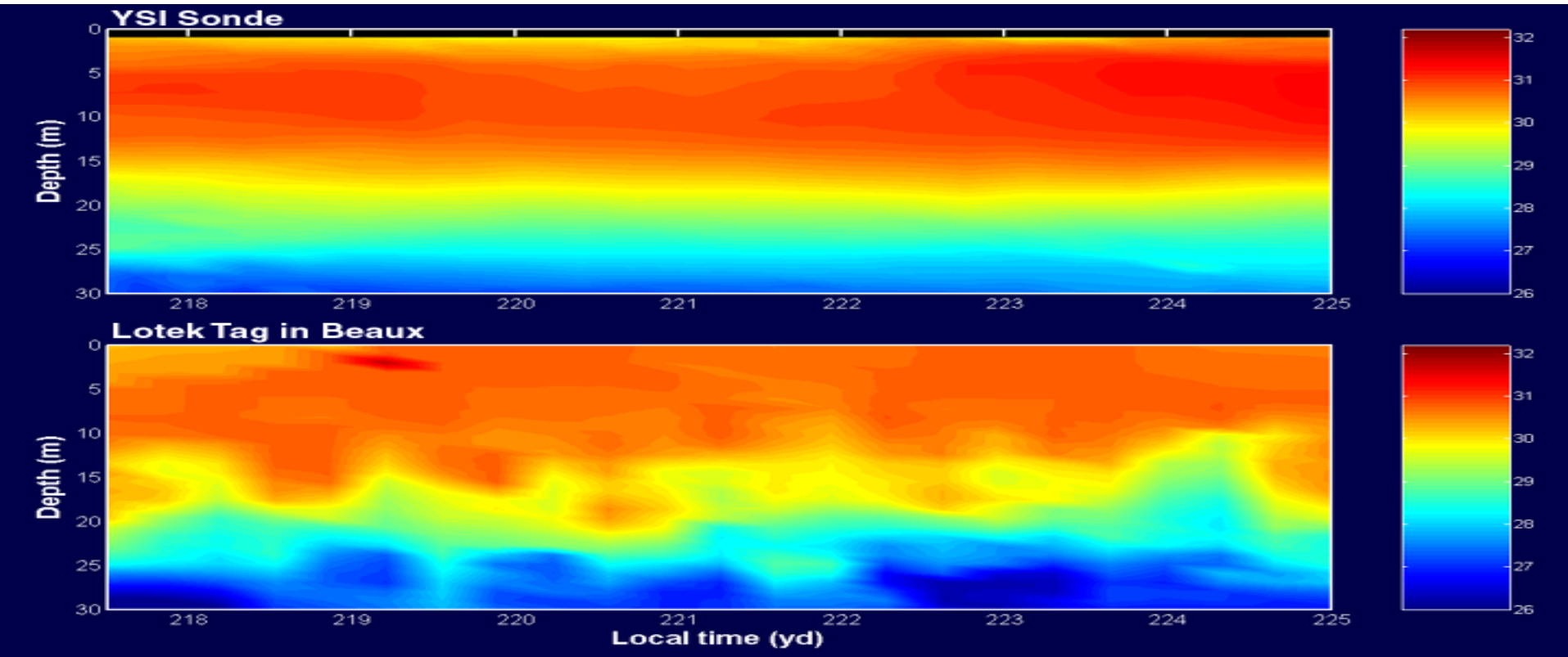
- Hurricane Cindy destroyed original hydrophone mounts
- Tropical Storm Dennis delayed start
- Drilling operations and power supply problems reduced number of satellite platforms available
- Hurricane Katrina ended data collection early and destroyed ~$20,000 worth of equipment

Challenges – 2006

- Damage from Hurricane Katrina and salvage operations reduced number of satellite platforms available
- Weather problems limited number of tagged fish
- One hydrophone leaked
- One hydrophone worked intermittently
- Difficulties downloading data from 3 more hydrophones

Additional Blue Runner Research

- Bioenergetics
  - Swimming speed
  - Distribution relative to water temperature



Summary

- Blue runner school near platforms in upper 20 m during day feeding on zooplankton and small fish
- Descend to ~25 m at night, disperse, and make forays into illuminated zone to feed on micronekton and macrozooplankton – bioenergetic subsidy from platforms due to light
- Little evidence that unmanned platforms are as important as foraging sites as the manned platforms
- Establish a home range within the complex ... why?
- Consumed by larger predators fueling pelagic food web

Reference

Burt, W. H. 1943. Territoriality and home range concepts as applied to mammals. Journal of Mammalogy 24:346–352.

Photo by S. Keenan