



# Spatial and Temporal Variation of KITTLITZ'S AND MARBLED MURRELETS IN GLACIER BAY: Implications for Survey Design



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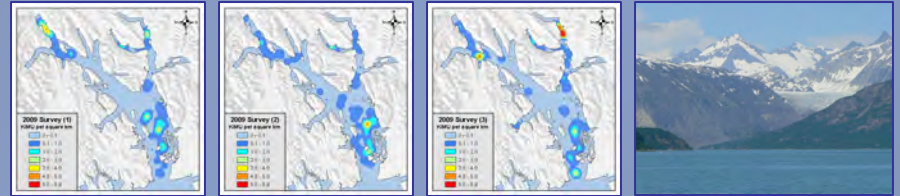
## LOCATION AND METHODS

We conducted 3 replicate at-sea surveys of *Brachyramphus* murrelets in Glacier Bay, Alaska 3-9 July 2009.

- Two vessels: *RV Sierra*, 10.7 m; *RV Gravina*, 15.9 m.
- 41 transects throughout the bay conducted in a zigzag pattern using strip transect method: 150 m on either side of centerline (300 m total width).
- Each murrelet location recorded using a GPS.
- 8 x 42 binoculars used to identify Kittlitz's and Marbled Murrelets.
- Rangefinders used to confirm distances.
- Density maps showing murrelet "hot spots" were created using the kernel density function (ESRI ArcGIS Spatial Analyst) with a 3 km search radius. Results are birds/km<sup>2</sup> for each 25 m grid cell.
- Habitat preferences defined as an "electivity coefficient" index equal to the use of a habitat divided by that habitat's availability.



## HOT SPOTS

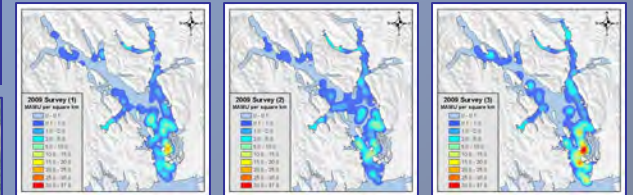


Kittlitz's Murrelets

- Areas with highest densities of Kittlitz's Murrelets shifted between the 3 surveys conducted within a 7-day time frame. Hot spots alternated between the West Arm, the East Arm, and the Beardslee Islands in southern Glacier Bay.
- Marbled Murrelets were concentrated in the southern half of Glacier Bay, but at greatly varying densities among the 3 surveys, suggesting significant influxes of murrelets from outside of the bay.

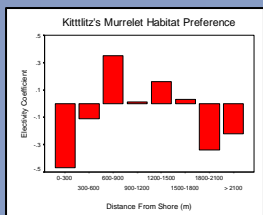
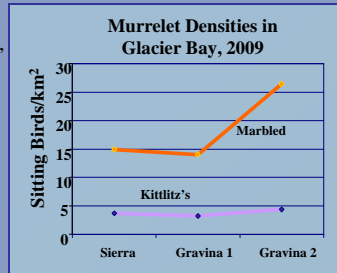
Survey 1: *RV Sierra* 3-9 July  
Survey 2: *RV Gravina* 3-6 July  
Survey 3: *RV Gravina* 7-9 July

## Marbled Murrelets

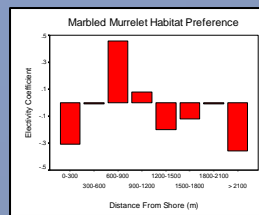


## DENSITY ESTIMATES

- In back-to-back surveys with the same methods, observers, and weather conditions, overall densities of murrelets in Glacier Bay greatly increased from one survey to the next:
  - ✓ Marbled Murrelet densities nearly doubled from 14.0 birds/km<sup>2</sup> to 26.4 birds/km<sup>2</sup> between the first and second *RV Gravina* surveys.
  - ✓ Kittlitz's Murrelet densities increased from 3.2 birds/km<sup>2</sup> to 4.4 birds/km<sup>2</sup> between the first and second *RV Gravina* surveys.



- Marbled Murrelets avoid waters within 300 m of shore, and greater than 1200 m from shore. They strongly prefer waters 600-900 m from shore.
- Kittlitz's Murrelets avoid waters within 300 m from shore and greater than 1800 m from shore. They prefer waters 600-900 m and 1200-1500 m from shore.



## CONCLUSIONS

- Significant within-survey and between-survey variability exists.
- Multiple surveys are required annually to capture this variability.
- Surveys should be conducted perpendicular to shore to capture distance-from-shore variability in murrelet densities.
- Significant daily influxes of murrelets into Glacier Bay makes it difficult to define the populations using the bay.



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Murrelet photos courtesy of John Schoen. Glacier Bay photo courtesy of Holly Hughes.