## Saildrones in the Bering Sea: Using unmanned surface vehicles to examine

relationships between northern fur seals and their prey

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#### **Innovative Technologies for Arctic Exploration –**

Lead the development and deployment of innovative technologies in the harsh and extreme environment of the Arctic.





Cross et al., 2015. Innovative technology development for Arctic exploration. In Oceans' 15 MTS/IEEE. Calvin.W.Mordy@noaa.gov, Christian.meinig@noaa.gov, Jessica.Cross@noaa.gov



NOAI

#### Saildrone: unmanned, wind- and solar-powered sailing vehicle

N

UNMANNED SCIENCE

100

3

4.5 m

Wind power for propulsion

Solar power for electronics

Satellite link for live data



Improving our Observational Infrastructure

#### SAILDRONE GEN 4 SPECIFICATIONS AND SENSOR SUITE

noar



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#### Northern fur seal demography





## **Annual Cycle**

#### Demography reflects winter and summer conditions





#### **Summer foraging behavior**





#### **Northern fur seal Conservation Plan:**

- 1. Improve knowledge of the numerical and functional relationships between fur seals, fisheries, and fish resources.
- 2. Conduct oceanographic and fishery surveys based on fur seal habitat use.





## Saildrone Missions 2016 & 2017

To help understand how changes in the ocean are affecting weather and climate, and to monitor whales, fish, and fur seals in the Bering Sea.

- 1. Engineer, test and develop oceanographic sensors and sampling schemes. Collect near real-time oceanographic data.
- 2. Test and deploy a low-power echosounder to expand AFSC's bottom and mid-water trawl surveys for walleye pollock.
- 3. Test autonomous passive acoustic recorder to document the presence of marine mammals, specifically the North Pacific right whale.
- 4. Map vertical and horizontal distribution of walleye pollock to examine fine-scale relationships between prey availability and northern fur seal foraging behavior.





## 2016 Research

- 2 Saildrones Bering Sea
- 103 day mission
- 11,971 km covered (total)
- Launch: 23 May
- Recovery: 3 Sept
- 65 sampling days in core fur seal area

#### **2017 Research**

- 1 Saildrone Bering Sea, 2 Arctic
- 76 day mission
- 42,911 km covered (total), ~14,000 km in Bering
- Launch: 17 July
- Recovery: 29 Sept
- 36 sampling days in core fur seal area







## 2016 Research

- 2 Saildrones Bering Sea
- 103 day mission
- 11,971 km covered (total)
- Launch: 23 May
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**OAA FISHERIES** 

• 65 sampling days in core fur seal area



#### **2017 Research**

- 1 Saildrone Bering Sea, 2 Arctic
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## **Fish acoustics**



- Map pollock abundance and depth distribution in the core fur seal foraging area
- Backscatter classified as shallow, age-0 and deeper, adult pollock



#### Walleye pollock backscatter (2016)







12 fur seals: similar relationship with age-0 pollock



# 4 fur seals: positive relationship with adult backscatter





## **Differences in fur seal dive behavior**



- Mean dive depth decreased
- Dives to the mixed-layer depth increased
- Wiggles increased



- Mean dive depth increased
- Dives per hour decreased
- Wiggles decreased





## **Focal follows**

- Tested ability of Saildrone to conduct remote-focal follows
- Prey availability and oceanographic conditions while following tracked fur seals
- Followed foraging path for ~2 days (2016: 2, 2017: 4)
- In 2017 focal follows concentrated on camera equipped seals



#### Small pollock (video)





#### Large pollock (video)





#### **Fur seal research summary**

- Saildrones successfully mapped fur seals prey landscape during the important breeding period
- Simultaneous tracking of fur seals used to examine how fur seals respond to variation in prey resources
- Ultimate goal is to link behavioral changes with measures of foraging and reproductive success



#### Next steps: continue multi-division collaborations

Integrate results with historic data, demographic data, and into ecosystem models for the Bering Sea

- 863 fur seals tracked, >1.5 million hourly locations, > 4 million dives of all age/sex classes
- Annual assessments of walleye pollock- bottom trawl, mid-water acoustic trawl, Saildrone, and age-0 pollock surveys
- Integrate with AFSC's ecosystem models - FEAST- Forage Euphausiids Abundance in Space and Time, CEATTLE- Climate Enhanced, Agebased model with Temperaturespecific Trophic Linkages and Energetics



#### **QUESTIONS?**

#### **Funding and support**





ITTAE







#### More information at:

https://www.afsc.noaa.gov/Science\_blog/FurSeals\_2016\_main.htm

https://www.pmel.noaa.gov/itae/follow-saildrone-2017

Mordy, C.W., et al. 2017. Advances in ecosystem research: Saildrone surveys of oceanography, fish, and marine mammals in the Bering Sea. Oceanography 30(2), https://doi.org/10.5670/oceanog.2017.230.

