

The Chute Camera

**Developing an automated tool to measure
halibut bycatch onboard trawlers**

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AFSC FMA EM Innovation Project (EM development)

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Kodiak camera chute project - Tests aboard Kodiak trawlers

FishNext Research (Craig Rose)

Alaska Groundfish Data Bank (Julie Bonney and Katy McGauley)

Funded by NOAA's Saltonstall-Kennedy Program



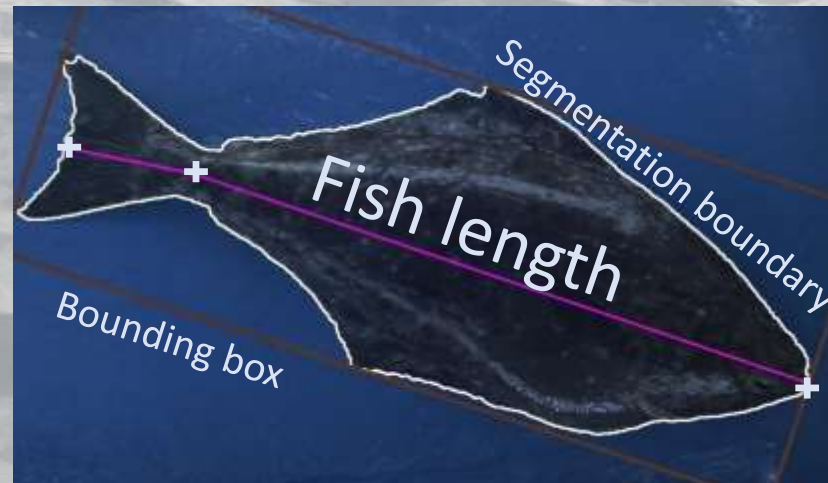
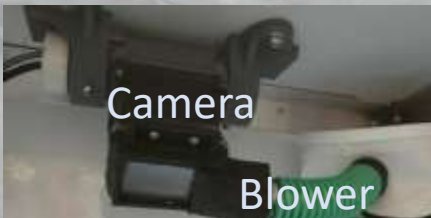
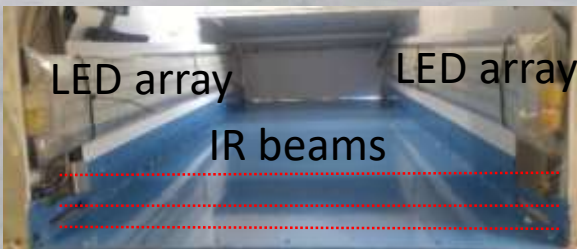
Camera Chute Configuration



- Aluminum enclosure – controlled lighting
- Electronic interface and computer for image storage / processing
- LED light strips and contrasting background
- Light beam break detector/trigger (replacing with line scan camera)
- Machine vision camera (blower to clear port)



- Fish slides through chute
- Breaks light beams triggering strobes and camera
- Image to computer for processing



Camera Chute Deployments

- Prototype on Bering Sea trawler (2014)
- Trawl survey – 146 species (2015 - 16)
- Bering Sea deck-sort tests (2015 – 18)
 - 6 deployments – up to 2 months
- Gulf of Alaska trawlers (2016 – 18)
 - 8 vessels, 14 trips
- Progressive improvements, based on issues identified at-sea
 - More robust in all conditions
 - Familiarity and feedback from fleet



2014 prototype



2015 GOA survey



2016 GOA trawler



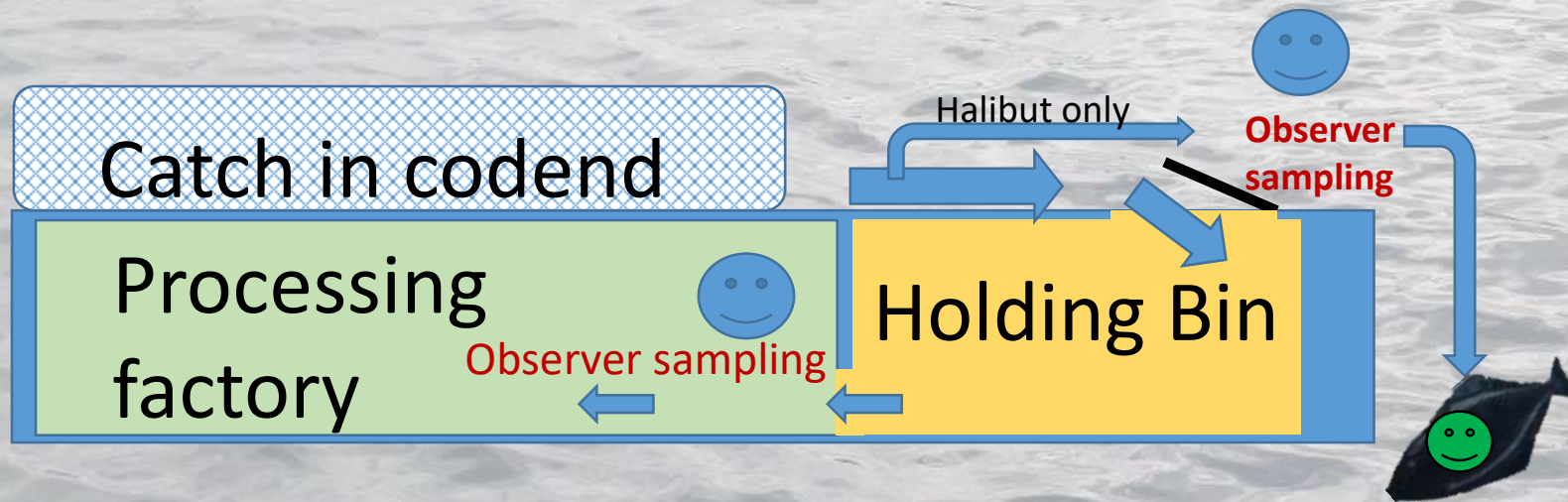
2018 Design on Bering Sea trawler

Bering Sea - Expedited halibut release

(Deck sorting under Exempted Fishery Permits)



Process to expedite halibut release



Quick release means most halibut released alive and many more survive

Two observer sampling stations

Factory stops when observer monitoring deck

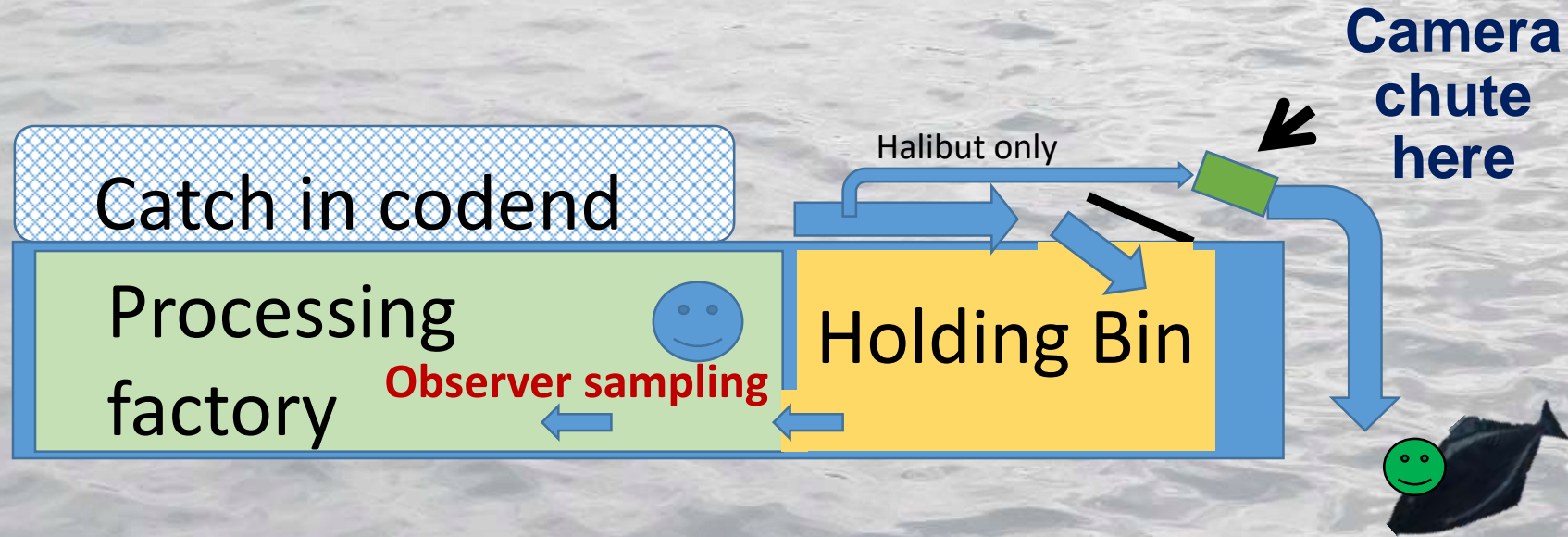
Automation can make expedited release of halibut easier and more practical

- Camera chutes provide quick, accurate measurements of halibut bycatch from images taken as halibut are released by sliding through the chute
 - They also provide time of release/time on deck (related to mortality)



2017 Bering Sea deck-sorting chute

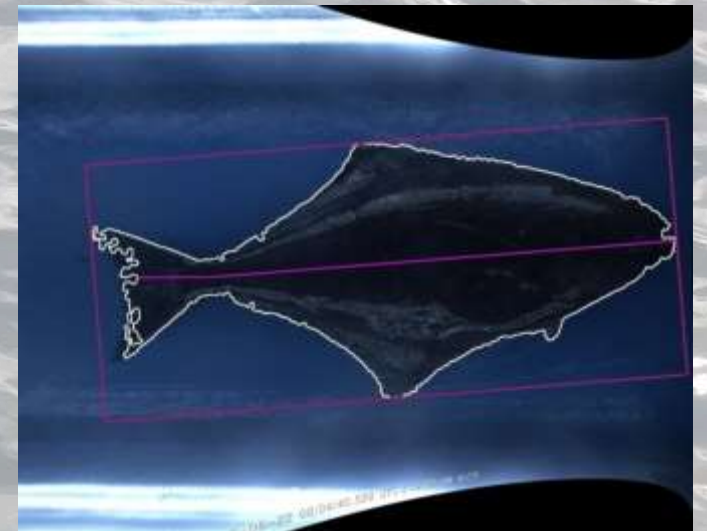
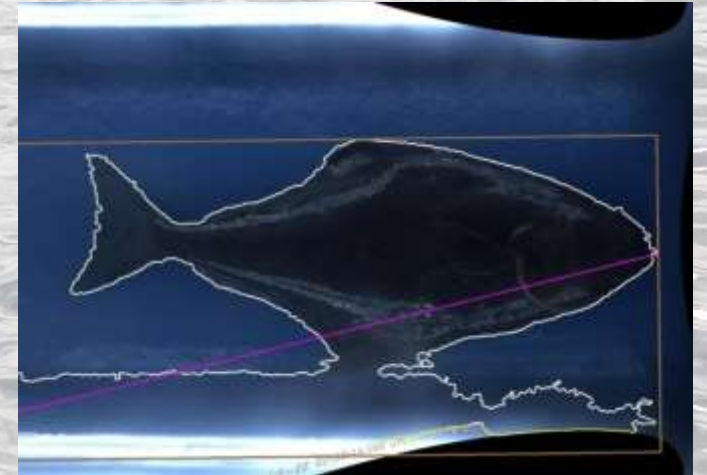
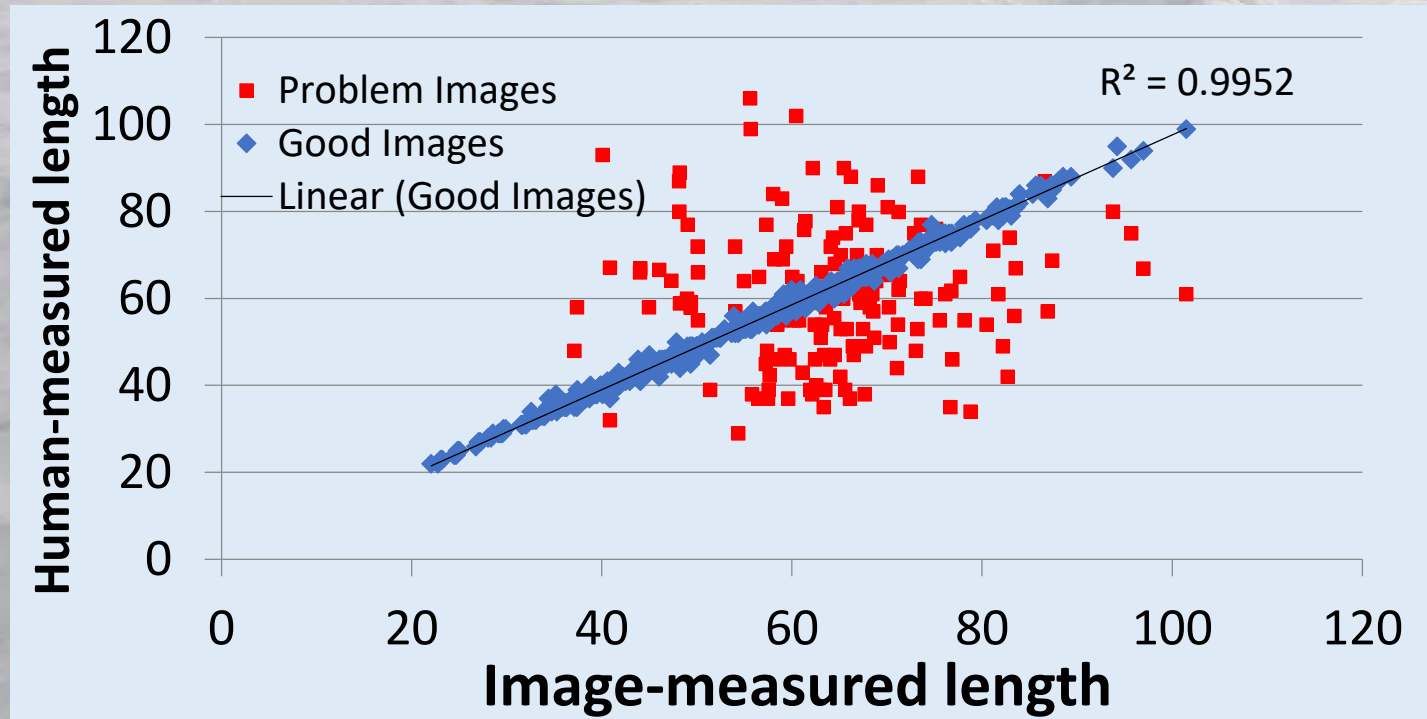
Addition of Camera Chute



Camera chute collects halibut lengths and time-on-deck
Observer will still need to collect some viability scores

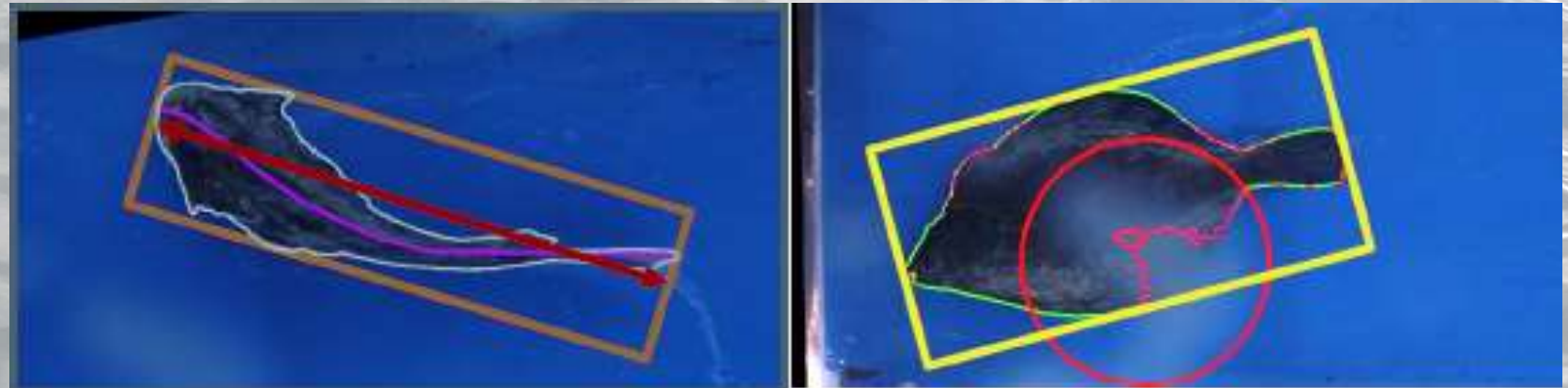
Camera chute performance

- 2015 results –
 - Very accurate when images are good (blue)
 - Tools to prevent, measure, or detect poor images (red) have since been developed



Software Improvements

- Improved segmentation
- Adjustments for changing backgrounds
- Detect flopping halibut (tail area proportion)
- Water drop and blur detection
- Three point measurement for halibut
 - midline measurement for other species



Hardware Improvements

- Vibration resistant electrical connections
- Rigid, hinged doors – eliminated light intrusion and false triggers
- Better waterproofing – connectors, housings
- Lens clearing – blower first, then freshwater spray
- Triggering!
 - Stacked line break sensors (avoids late triggers)
 - Still first component to fail
 - Line scan camera – testing 2018

Camera chute research - Species Identification

- Identification from image recognition (2015 survey)

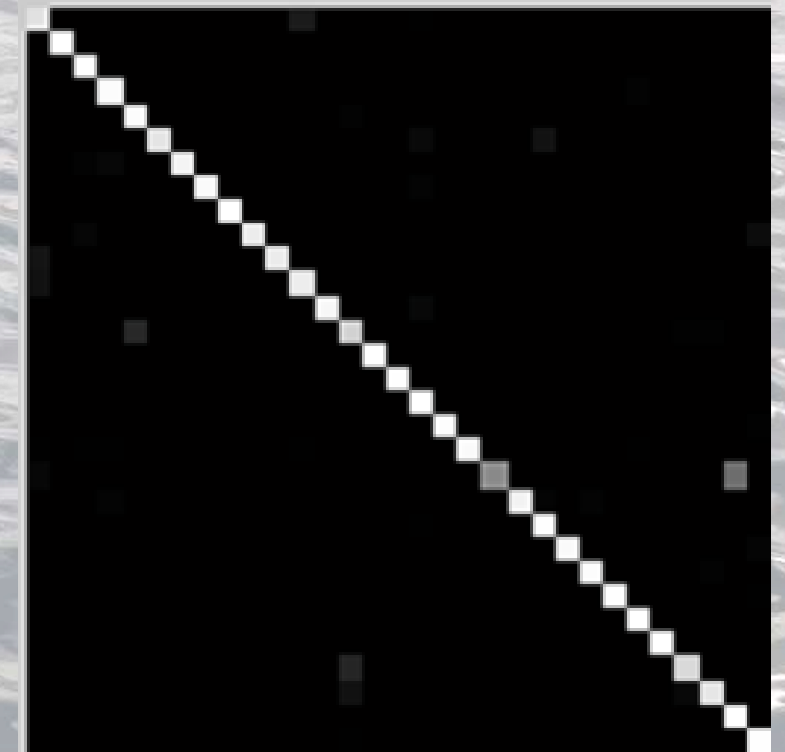
- Confusion Matrix

- | | |
|---------------------------------------|-------------------------------------|
| • Arrowtooth Flounder(436, 88.1%) | Northern Rocksole (753, 99.9%) |
| • Atka Mackerel (307, 100%) | Pacific Cod (223, 99.1%) |
| • Berryteuthis magister (131, 100%) | Pacific Ocean Perch (227, 97.8%) |
| • Black Spotted Rockfish (138, 98.6%) | Pollock (35, 54.3%) |
| • Darkfin Sculpin (158, 98.8%) | Prowfish (56, 94.6%) |
| • Dover Sole (55, 89.1%) | Rex Sole (433, 99.3%) |
| • Dusky Rockfish (66, 95.5%) | Sablefish (50, 98%) |
| • Flathead Sole (511, 97.9%) | Searcher (85, 98.8%) |
| • Giant Grenadier (40, 100%) | Short Spine Thornyhead (213, 99.5%) |
| • Gymnocanthus Galeatus (40, 92.5%) | Shortraker Rockfish (154, 100%) |
| • Halibut (38, 92.1%) | Stronglylocentrotus Sp (31, 100%) |
| • Kamchatka Flounder (553, 92.8%) | Triglops Forficata (46, 84.8%) |
| • Lycodes concolor (30, 96.7%) | Triglops Scepticus (60, 90%) |
| • Malacottus Zoneris (88, 81.8%) | Walleye Pollock (245, 100%) |
| • Mud Skate (48, 100%) | Yelllow Irish Lord (193, 99.5%) |
| • Northern Rockfish (385, 99.2%) | |

- Improves with more identified images

Predicted Labels

Ground Truth Labels



Remaining before camera chutes are ready for implementation

- Reliability – Must work without specialized personnel
 - Have gone from ‘sometimes fails on installation’ to ‘sometimes fails after weeks’
 - Need to at least get to ‘lasts for months’, preferably a full fishing year
- All bad images either measured correctly or identified as inaccurate
- Compliance monitoring – Assuring all halibut go through chute
- Commercialization
 - Project will provide open-source software and hardware designs
 - Someone will need to make chutes available as a product
 - Will need to include a maintenance infrastructure
- Acceptance (fishery, Council, stakeholders.... recognize need and value)
- Incorporate a different data stream into management system

The background of the image is a close-up, top-down view of water with numerous small, concentric ripples. The water is a light, silvery-grey color, and the ripples create a textured, shimmering effect. The lighting is even, highlighting the peaks and troughs of the waves.

Questions?