Space-time modelling of survey data

Agenda Item 6.2
IPHC-2017-IM093-07

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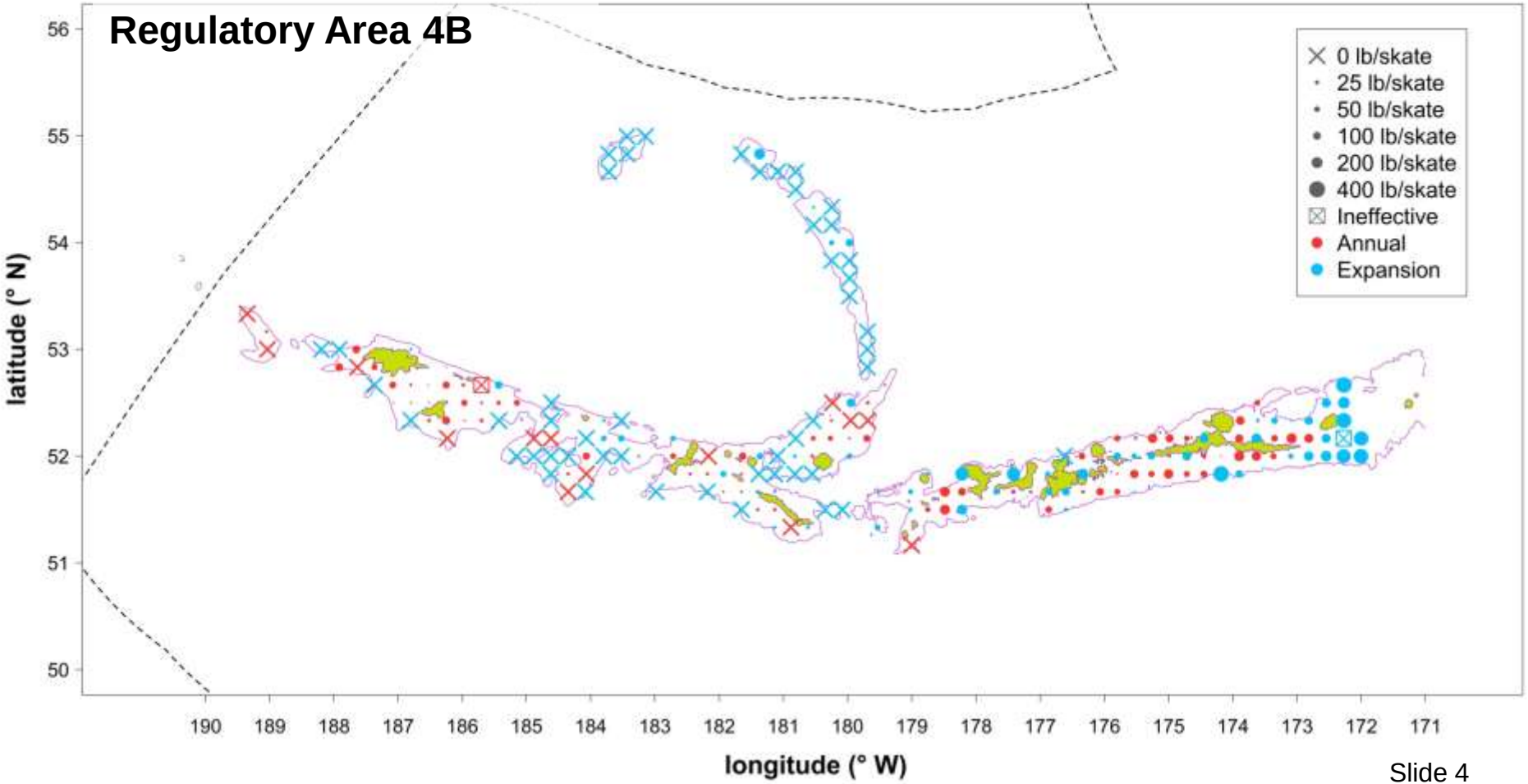
INTERNATIONAL PACIFIC HALIBUT COMMISSION

Outline

- Setline survey expansion results
  - Areas 4B and 2A
- Output of space-time modelling
  - O32 WPUE, total WPUE and NPUE
- Evaluation of the need for future survey expansions
  - Areas 2A and 4A

Setline survey expansion results

- Regulatory Area 4B
  - Addition of deep (> 503m, >275 fm) and shallow (18-37 m,10-20 fm) stations
  - Large coverage gaps surveyed for first time:
    - Bowers Ridge
    - East Andreanof Islands
    - Around Amchitka I. and between Attu and Kiska Is.
- Regulatory Area 2A
  - Expansion in CA to 37.75°N
  - Repeat of deep, shallow and Salish Sea expansions (done previously in 2011 and 2014)
  - Dense grid off the north WA coast


Regulatory Area 4B
0 lb/skate
25 lb/skate
50 lb/skate
100 lb/skate
200 lb/skate
400 lb/skate
Ineffective
Annual
Expansion
latitude (° N)
56
55
54
53
52
51
50
longitude (° W)
190
189
188
187
186
185
184
183
182
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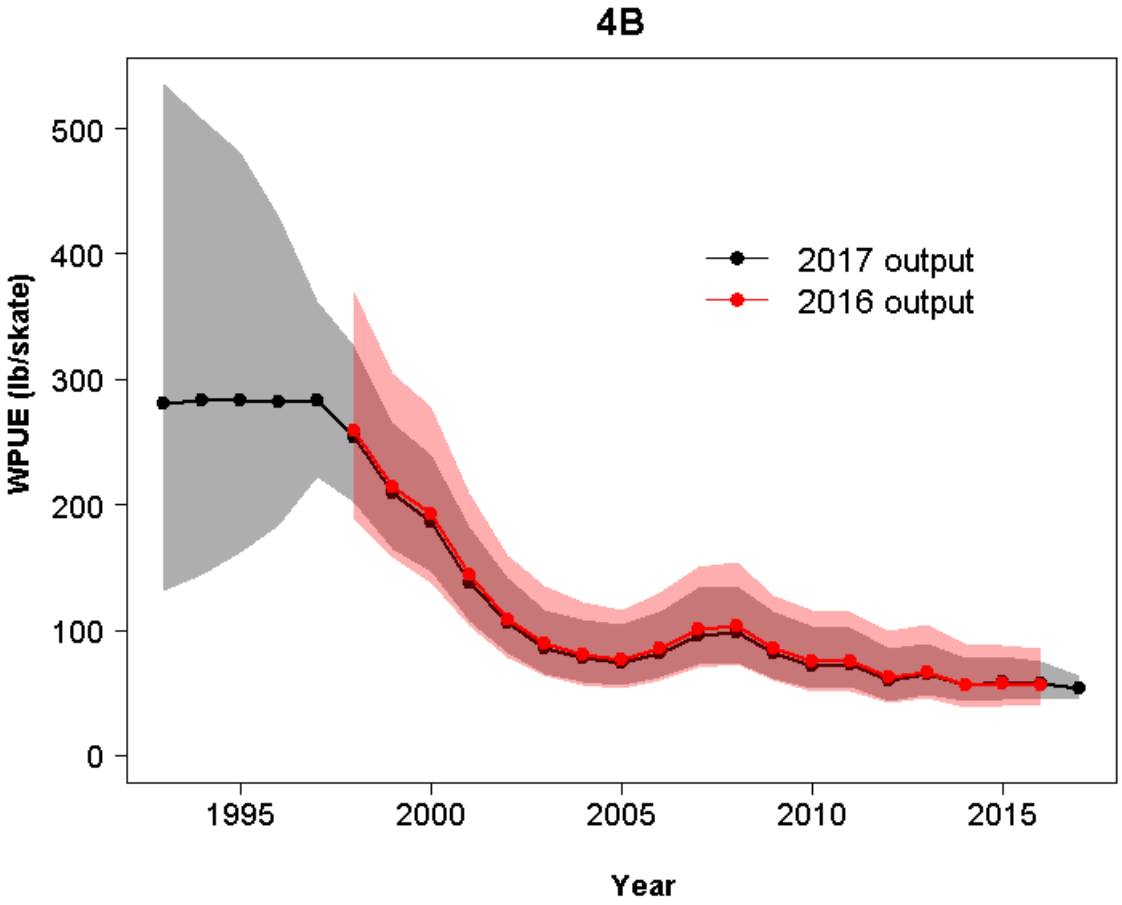
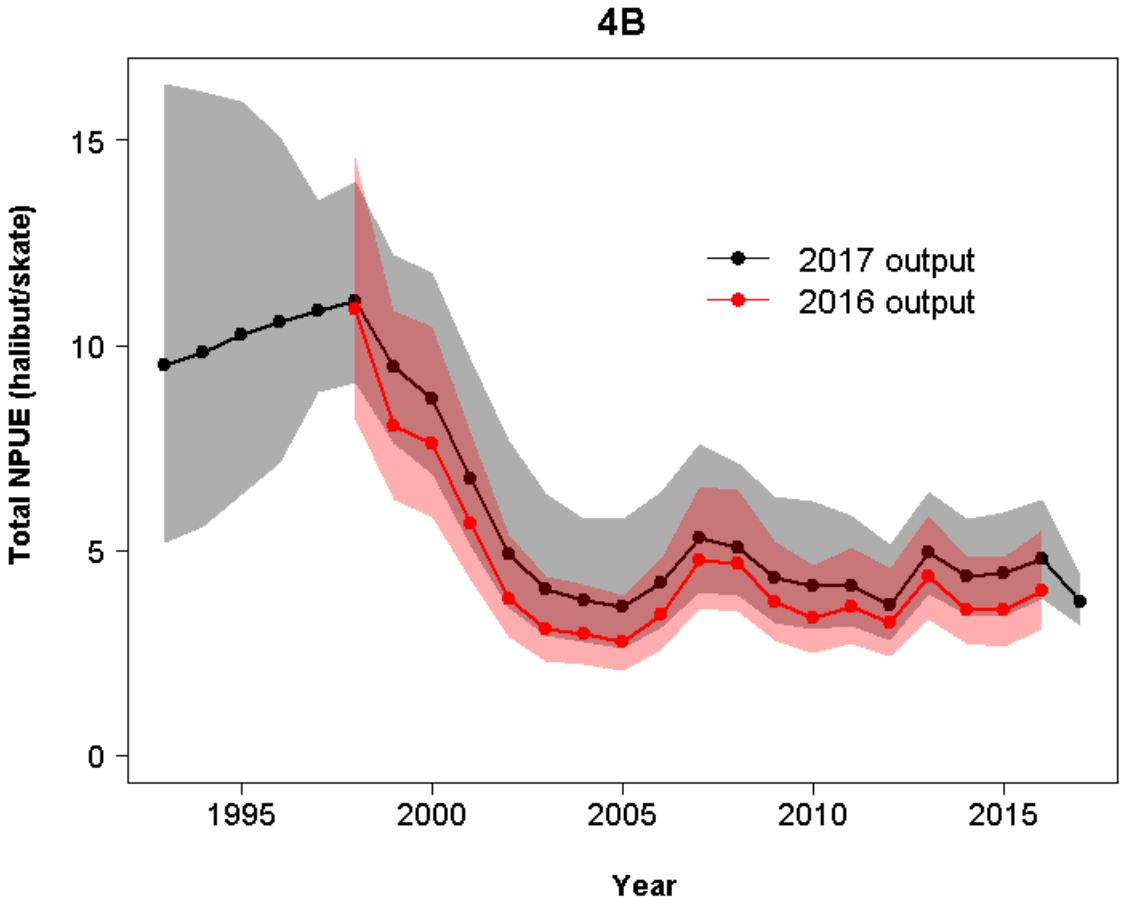
171

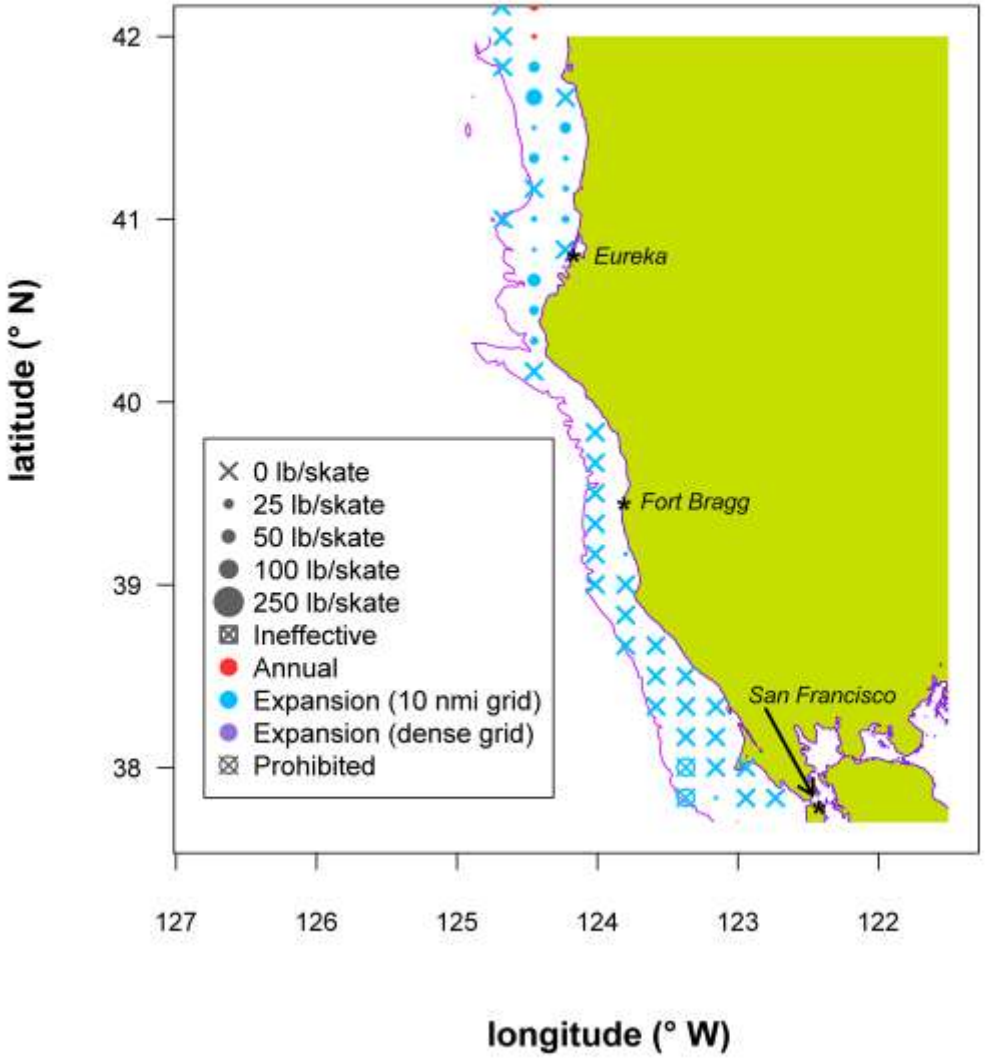
O32 WPUE


4B
WPUE (lb/skate)
500
400
300
200
100
0
1995
2000
2005
2010
2015
Year
2017 output
2016 output

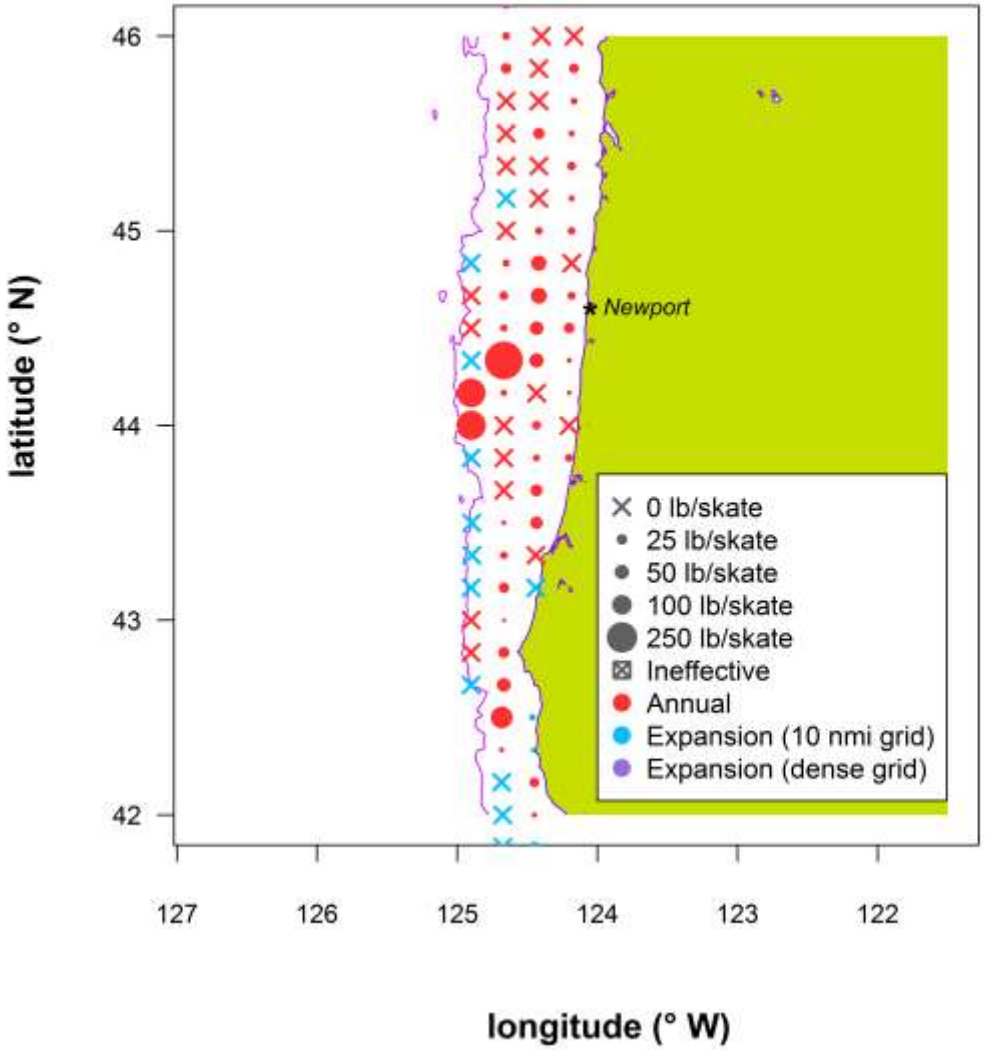
Total NPUE


4B
Total NPUE (halibut/skate)
0
5
10
15
1995
2000
2005
2010
2015
Year
2017 output
2016 output

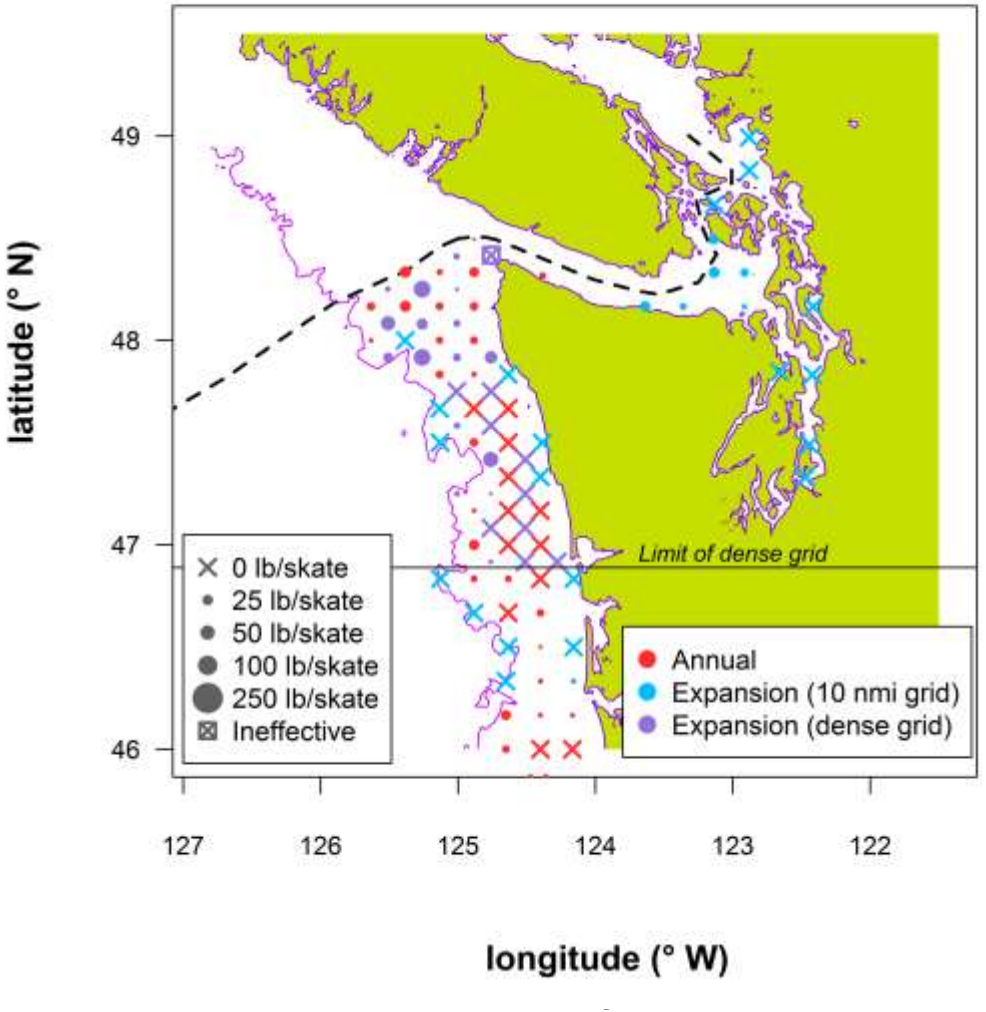
Area 2A
California



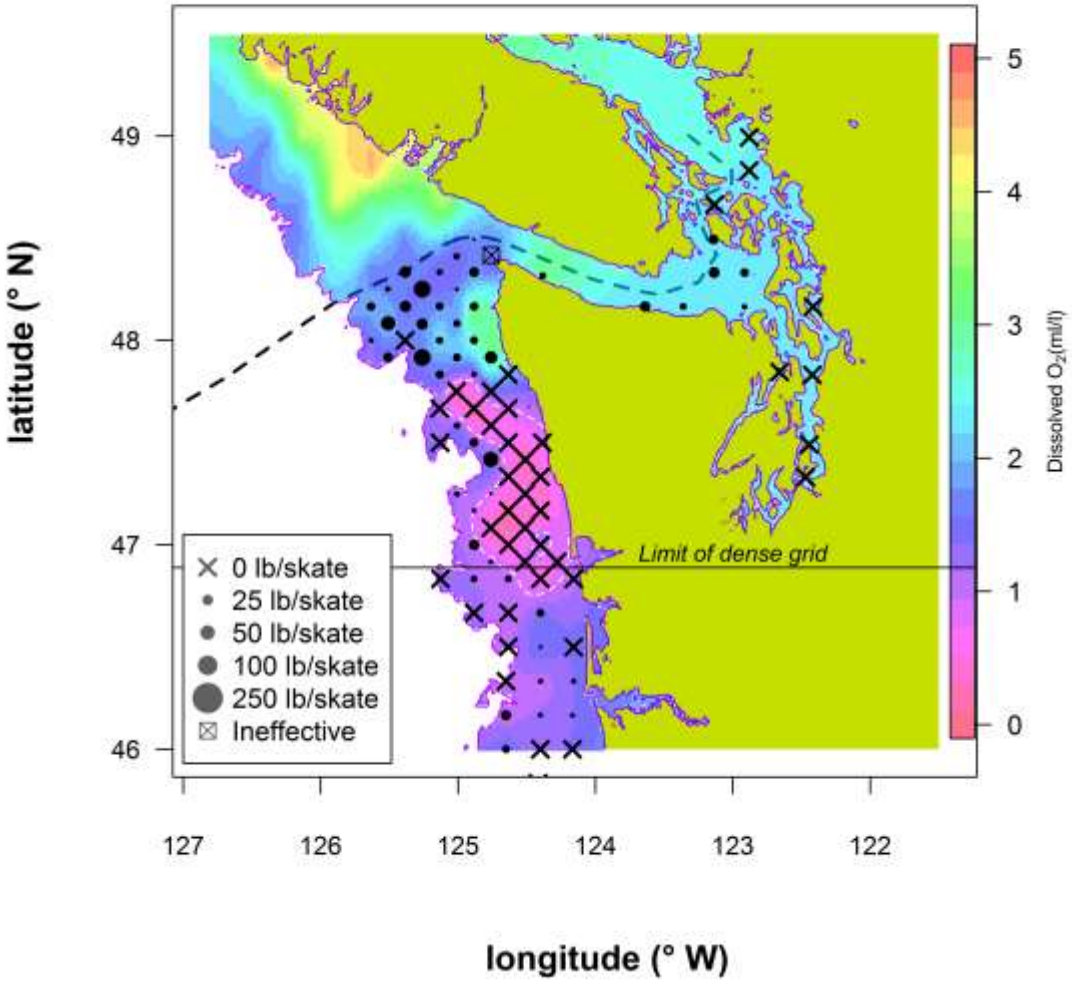
Area 2A
Oregon



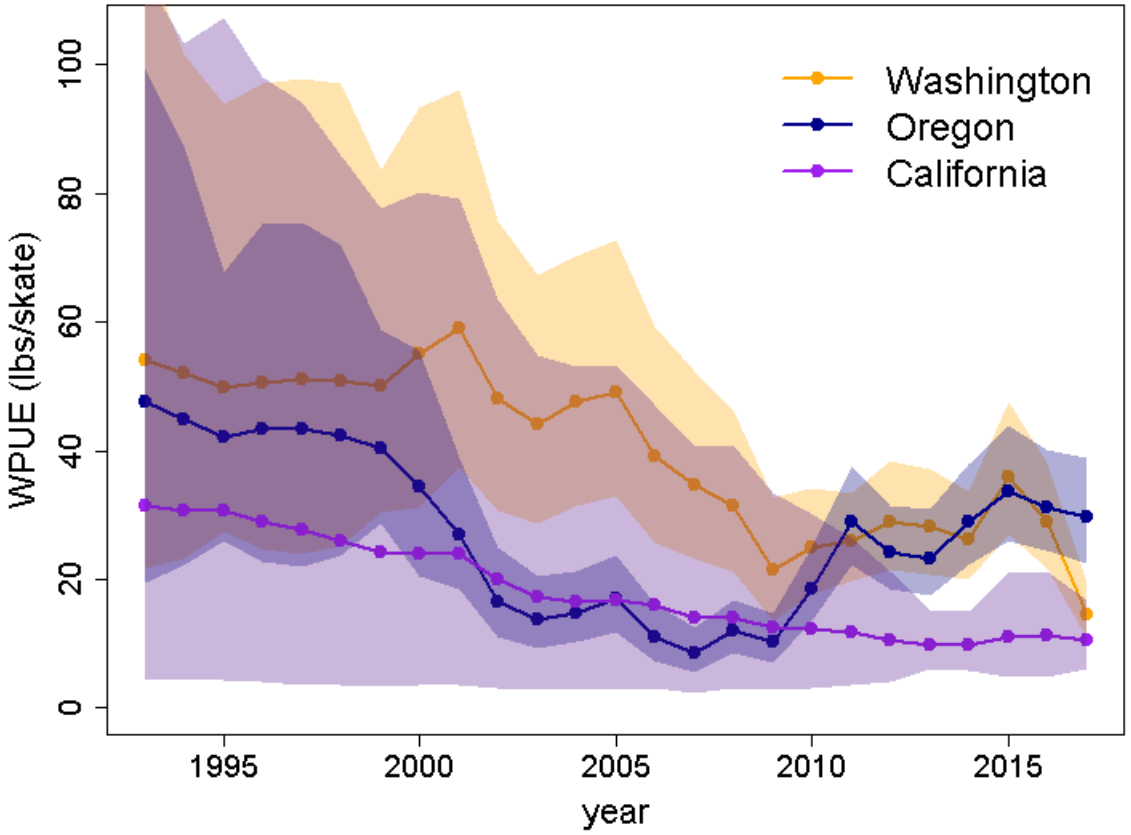
Area 2A
Washington



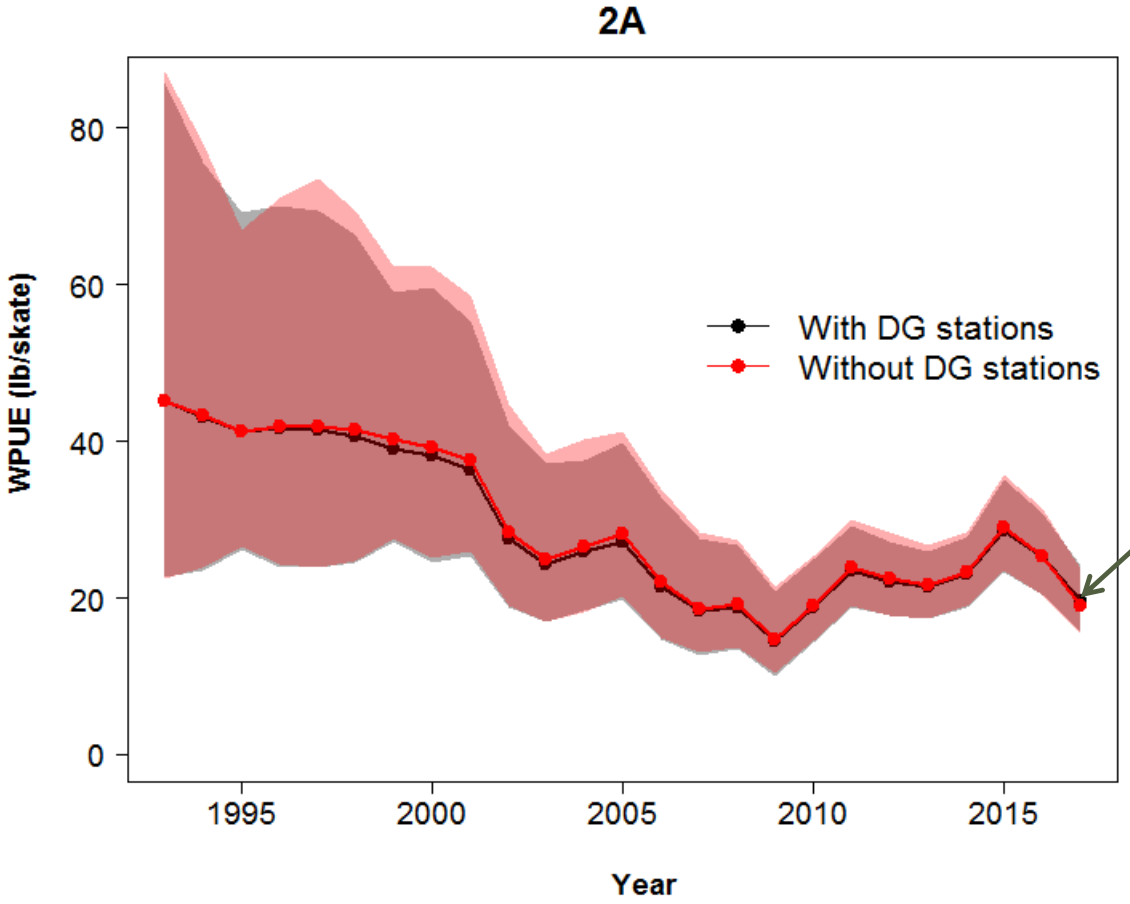
Area 2A
Washington
+ dissolved O_2



O32 WPUE
Area 2A by state



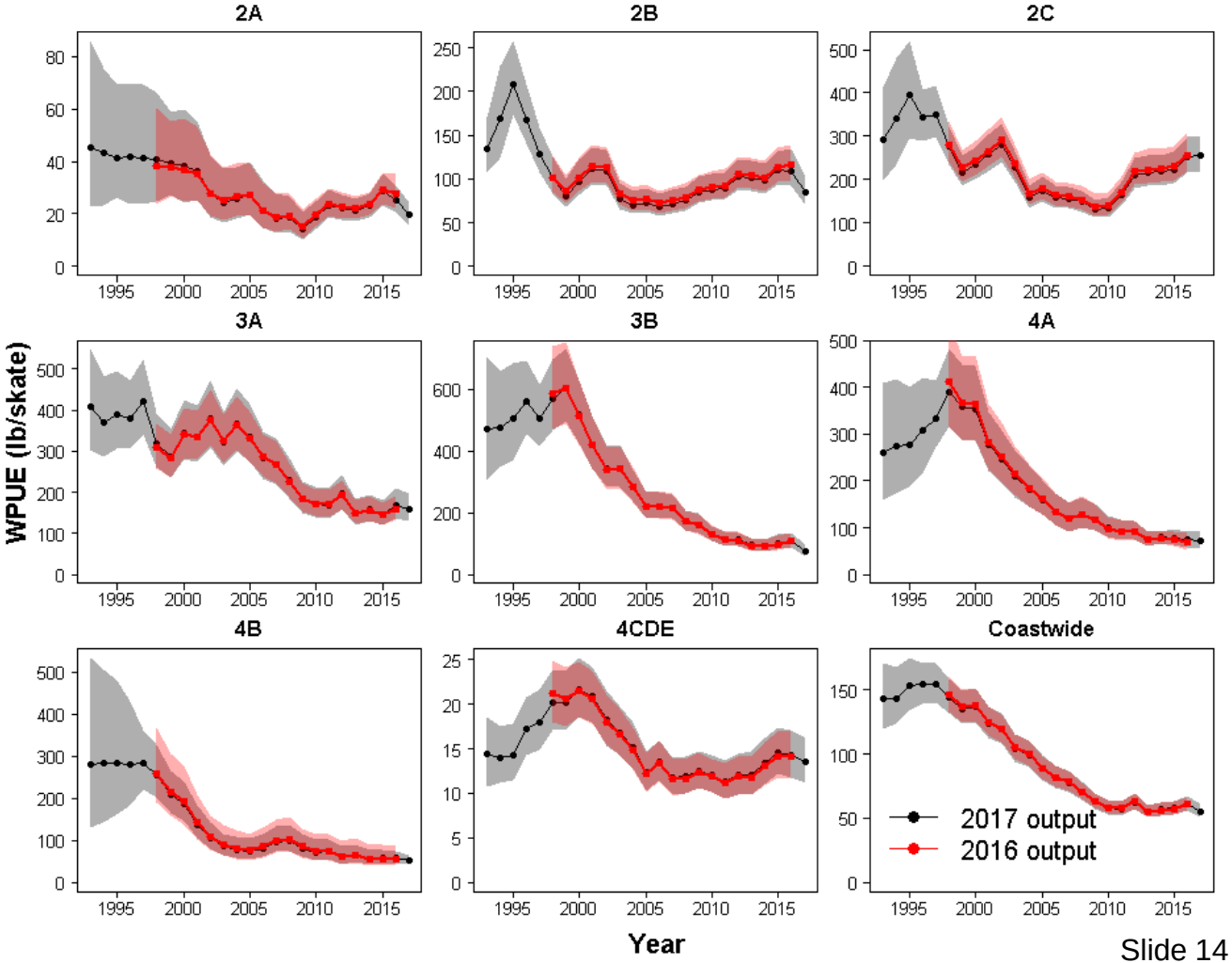
O32 WPUE


2A
WPUE (lb/skate)
80
60
40
20
0
1995
2000
2005
2010
2015
Year
With DG stations
Without DG stations
+2.8% in 2017

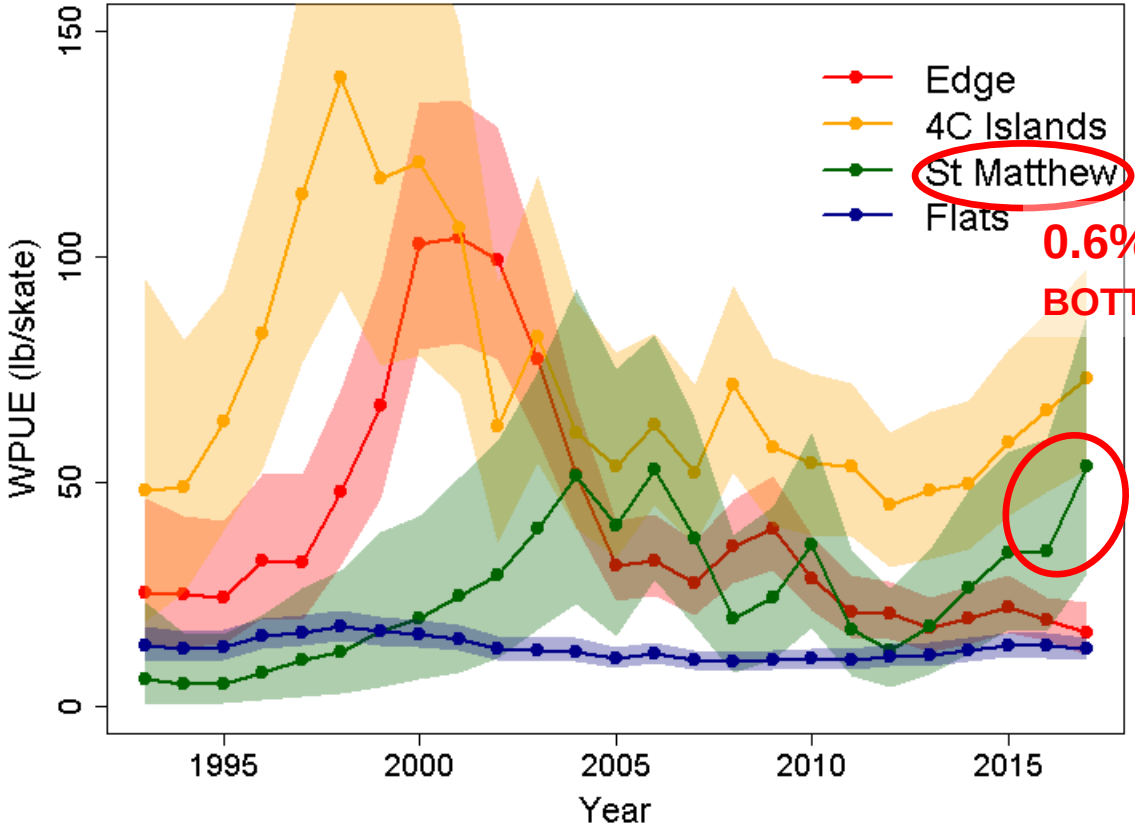
Space-time modelling updates in 2017

- Inclusion of data from 1993-1997 IPHC setline surveys
- In Area 2A, use of a covariate to indicate north and south of 40°N
  - Very low densities south of 40°N
  - Inclusion of this covariate improves prediction in this southern region in unsurveyed years
- Total WPUE modelled in 2017
  - Only O32 WPUE and total NPUE were modelled in 2016
- Bottom area estimates were updated for all Regulatory Areas

O32 WPUE 2016 and 2017 modelling

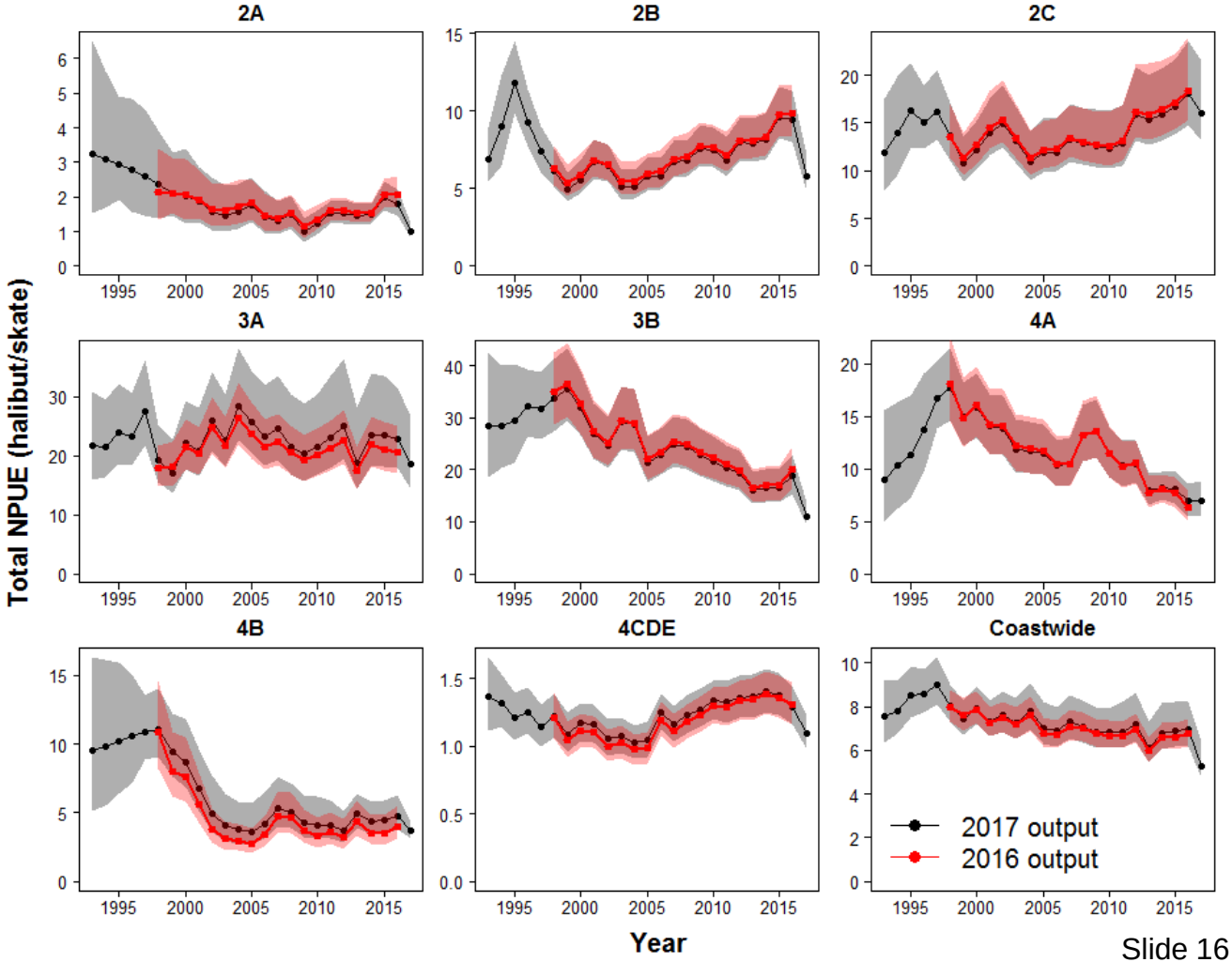


O32 WPUE
Area 4CDE split

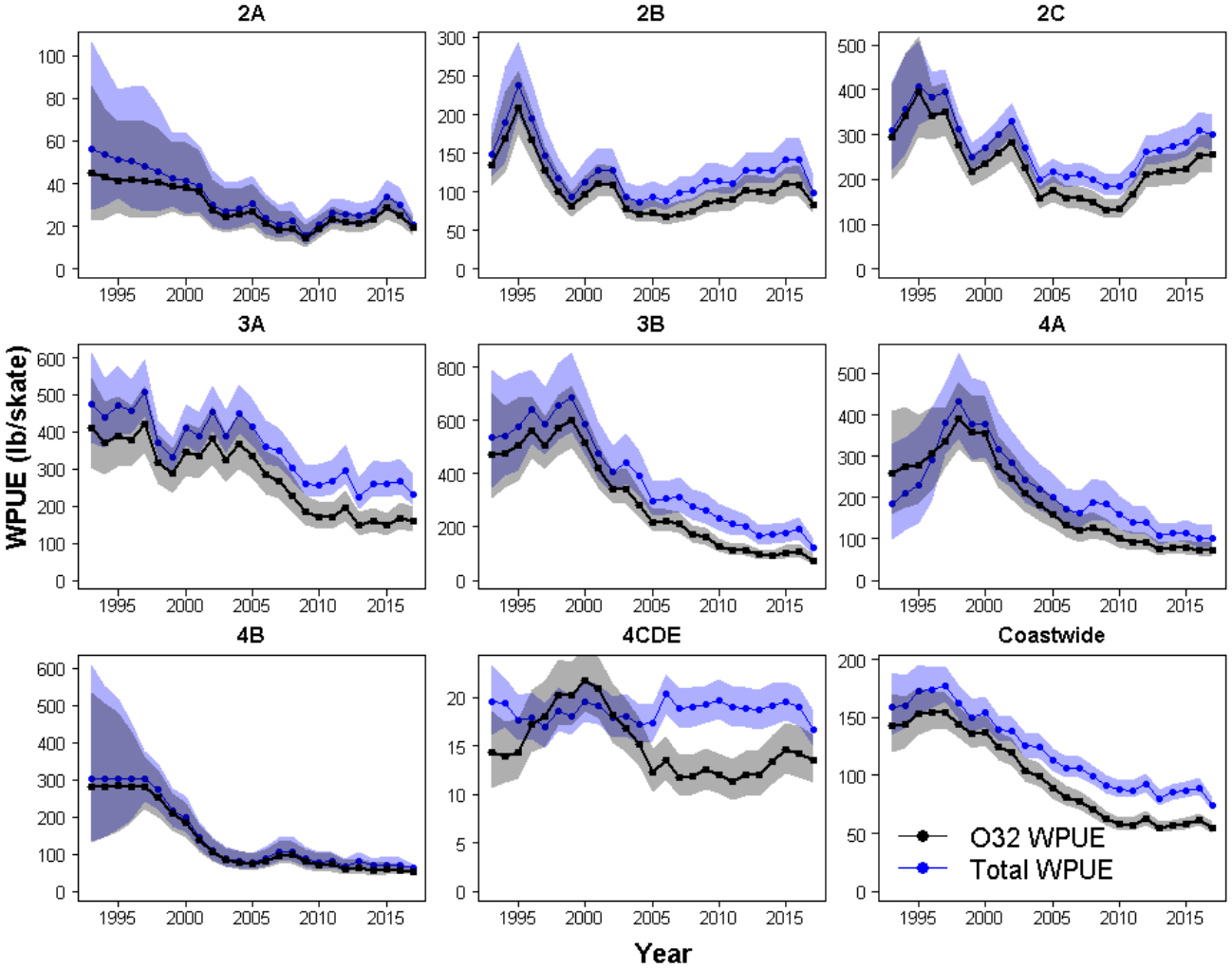


0.6% OF 4CDE BOTTOM AREA

Total NPUE 2016 and 2017 modelling



O32 & Total WPUE 2017 modelling



Evaluation of future expansion frequency

- Commissioners requested we evaluate how frequently IPHC setline survey expansions should be repeated in the future.
- Evaluation requires expansion to have already been completed in a Regulatory Area.
- It also helps for some time to have passed since the expansion.
- Here we use the space-time modelling to evaluate the effect of expansions in survey coverage on mean WPUE estimates in Regulatory Areas 2A and 4A.

Evaluation approach

- We compare models fitted to the data excluding subsets of setline survey expansion stations with the model fitted to the full data set.
- Allows us to:
  - assess the benefits in terms of relative error and precision of having expansion data available
  - to examine how error and precision change with time since the expansion took place
  - for Area 2A, examine whether there is an additional benefit of having the 2014 expansion data along with the original 2011 expansion data

Area 2A

- Annual setline survey of 96 stations in WA and OR in depths of 37-503 m (20-275 fm).
- Setline survey expansions:
  - 2011: Salish Sea and in depths of 18-37 m (10-20fm) and 503-732 m (275-400 fm) in WA and OR
  - 2013: California to 40°N (37-503 m only)
  - 2014: Salish Sea, California to 39°N, and 18-37 m and 503-732 m in WA, OR and CA

Area 2A: conclusions

- Large benefit in terms of relative error and precision from 2011 expansion (both depth expansion and Salish Sea expansion)
- Little additional benefit of 2014 repeat expansion north of 42°N
- Large benefit of California expansion in 2014
- **Getting baseline data from first expansion was very important**

Area 4A

- Annual survey of 110 stations along Bering Sea shelf edge (137-503 m) and Aleutian Islands (37-503 m).
- Survey expansion:
  - 2014: Coverage gaps and in depths of 18-732 m (10-400 fm) throughout Area 4A

Area 4A: conclusions

- Little benefit of 2014 shelf edge expansion stations
  - Annual NMFS trawl stations are near to and within this region
- Large benefit in terms of relative error and precision of 2014 expansion in the Aleutian Islands

Recommendations

Reg Area	Expansion region	Density†	Variability (spatial/ temporal)	Recommend FISS frequency
2A	Deep and shallow waters	Low	Low	≥ 10 years
2A	Salish Sea	Low-average	High	5 years
2A	Northern California	Average 40-42°N; low 39-40°N	Average	3-5 years
4A	Aleutian Islands	High	High	3-5 years
4A	Shelf edge	Average	Low	≥ 10 years

† Density relative to annually surveyed parts of the regulatory area

Please stand by as we bring up the next presentation

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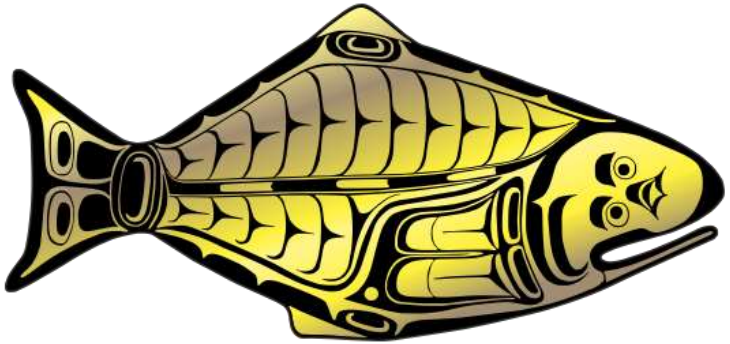

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