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## Sex-marking at sea and genetic validation of sex identification

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### PURPOSE

To provide an update regarding the status of studies designed to provide information regarding sex ratios in commercial landings of Pacific halibut.

### BACKGROUND

Declining size-at-age of Pacific halibut since ~2002 in conjunction with larger size-at-age in females and a constant minimum size limit have led to the expectation that directed Pacific halibut harvests have become increasingly composed of females. Understanding the sex ratio of commercial catches is critical for accurate estimation of parameters such as female spawning stock biomass; but sex data cannot be obtained from commercial landings due to the requirement that halibut be dressed at sea. In 2014, the IPHC initiated a program to generate commercial sex-ratio data that included: 1) the development of at-sea sex-marking protocols for commercial vessels, 2) testing of sex-marking methods suitable for use on commercial vessels; first in a single port (Homer: 2015), then a single regulatory area (2B: 2016), and finally coastwide (2017), and 3) the development of a genetic sex assay.

### DISCUSSION

#### *At-sea sex marking*

At-sea sex marking is accomplished by marking individual Pacific halibut during dressing, as follows: for females, two knife cuts made in the dorsal (upper) fin; for males, a single cut through the white-side gill plate. At-sea sex-mark data were voluntarily obtained from two vessels in 2015 resulting in 288 fish sampled; from 16 sampled offloads (317 samples) in Regulatory Area 2B in 2016; and from 84 offloads (929 samples) coastwide in 2017. To date, the data from the marking program have suggested that commercial vessels may capture Pacific halibut that are larger at-age than are encountered in the IPHC's fishery-independent setline survey, resulting in a higher proportion of female catch that would be predicted using those survey data.

Tissue samples collected during the 2017 fishing season have been archived and validation of individual sexes will be determined in 2018 using genetic tests (see next section). Following these assays a determination will be made regarding the degree to which the program as-conceived will satisfy assessment needs or will require modification. We will not pursue at-sea marking during the 2018 fishing season, but will refine the program in 2019 as informed by the analyses.

#### *Genetic assay*

Genetic assay development employed restriction-site associated DNA sequencing (RADseq) to identify single nucleotide polymorphisms (SNPs) that are linked to sex in Pacific halibut. Three genetic markers limited to females were investigated for use in sexing Pacific halibut and two were developed into simple TaqMan assays that can be conducted at the IPHC's Seattle

laboratory. Each genetic assay was in agreement with the visually-determined sex in 97.5% of the fish (n = 199) that were tested. The current cost of each assay is estimated to be \$0.60-0.70 US per fish, not including equipment and salary costs.

Additional information on the progress of studies designed to provide information on sex ratios in commercial landings of Pacific halibut can be found in IPHC-2017-RARA27-2.6.1.

**RECOMMENDATION/S**

That the RAB:

- 1) **NOTE** paper IPHC-2018-RAB19-08 which outlined current progress of the at-sea sex marking project and the development of genetic assays for sex identification.