

## 5.3 Clean otolith archive collection

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### Abstract

Recent trends in otolith research include analysis of trace element constituents of the otolith. Samples used in these types of analyses need to be free of contaminants, such as glycerin. The International Pacific Halibut Commission's otolith collection has primarily been composed of otoliths collected for age determination, which have been stored in a glycerin/thymol solution to increase readability. The clean otolith archive collection was started in 2010. Otoliths in this collection are stored dry for use in future elemental studies. A total of 902 otolith pairs were added to the clean otolith archive collection in 2016.

### Background

With the advent of new technologies, fisheries researchers have the ability to study the elemental constituents incorporated in the microstructure of the otolith. Otoliths are composed primarily of calcium carbonate (in the form of aragonite) in a protein matrix. Otoliths grow through the life of the fish through gradual accretion. Crystals of aragonite as well as trace amounts of other elements are added to the outer surfaces of the otolith in discrete increments that are stable over time. The most commonly measured elements are those that fall under the alkali, alkaline earth, and transition metals categories of the periodic table, which include, but are not limited to, beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and manganese (Mn). It is possible to detect and measure extremely small concentrations of these elements in otoliths, however any contaminants in the sample, such as glycerin (1, 2, 3-propanetriol), can make these measurements difficult to interpret.

The International Pacific Halibut Commission (IPHC) otolith collection has, by and large, been comprised of samples collected for age determination as a data input into the annual stock assessment. These structures have been stored in a solution of glycerin and thymol (2-isopropyl-5-methylphenol) that allows for increased readability. As useful as it has been, this collection has limitations for other research purposes. Otolith-based research has seen a shift from age and growth studies to isotopic and elemental analyses of otoliths (Campana 2005). Oxygen isotope analysis can be used to reconstruct thermal history, and stable isotope analysis (carbon and nitrogen) can provide information on a fish's dietary history. Trace elements in the otoliths can be used in conjunction with other sampling to identify nursery origin by analyzing the trace element composition of the core. Analyzing trace element composition over time within an otolith (by sampling material from sequential annuli along a transect of a sectioned otolith) can provide information useful to understanding migration (Campana and Thorrold 2001, Gao and Noakes 2012). A glycerin/thymol solution maintains readability in stored otoliths, enabling age determination; however, it renders these structures unusable for research involving some isotopic and all elemental analyses. While methodological problems with measurement of otolith trace elements remain (Geffen et al. 2013), it is likely that studies involving otolith elemental and isotopic analyses will become more useful as the technologies that underlie these studies become more reliable. To make structures available for future chemical analyses, a clean otolith archive collection (COAC) program was initiated in 2010.

## Collection

The COAC is composed of structures from IPHC otolith collection programs and other research opportunities, including: the fishery-independent setline survey (setline survey), commercial port sampling program, National Marine Fisheries Service (NMFS) trawl survey, and special charters that sacrifice Pacific halibut for research. These otoliths are collected along with any associated data, such as capture location and fork length, following the established collection procedures of the applicable program. Otoliths from the COAC are not used for age determination. They are cleaned, dried, and stored whole in climate-controlled conditions for future analysis.

There are separate annual COAC sampling goals for Pacific halibut caught on the setline and the NMFS trawl survey platforms. For Pacific halibut caught with longline gear (setline survey and commercial sampling program), the annual COAC sampling goal is to collect a random sample of 100 otolith pairs from each of IPHC Regulatory Areas 2A through 4B, and 100 pairs from Areas 4C and 4D combined. Ideally, all of these otoliths would come from the setline survey, because sex and exact capture location are available. However, in areas of lower catch, the setline survey otolith sampling rate may already be 100% to achieve the otolith target necessary for age determination. For these areas, COAC otoliths are collected from commercial deliveries. For the NMFS trawl survey, annual COAC sampling goals range between 210 and 250 otolith pairs, depending on the survey regions for a given year. Parts of the NMFS trawl survey occur in IPHC statistical areas not covered by the setline survey; in addition, the trawl survey encounters small Pacific halibut that are not caught on setline gear. A total of 902 otolith pairs were collected for the COAC in 2016.

### Setline survey

Sampling for the COAC began on the setline survey in 2010. To achieve a per-area target of 100 otolith pairs, setline survey otolith sampling rates were increased by approximately 5% for each regulatory area, excluding those areas that required a 100% sampling rate to meet the otolith target for age determination. In 2016, otoliths were collected for the COAC from Regulatory Areas 2B through 4A. Selection of fish to be sampled was determined from area-specific random number tables for both the COAC and age determination otolith collections. The otolith sampling rate for age determination was 100% for Regulatory Area 4C in 2016, however a few COAC otoliths were collected (samplers mistakenly used the Area 4A random number table on four stations in Area 4C). In Area 4D, 75% of the Pacific halibut were to be sampled for age determination and in the other 25%, Pacific halibut less than 32 inches (81.3 cm) in fork length were to be tagged. However, 14 COAC otoliths were collected from the tagging subsample on one vessel. COAC otoliths were placed in black Tray Bien™ storage trays to prevent confusion with the standard blue Tray Biens™ utilized for the setline survey. COAC totals for the setline survey were 530 otolith pairs. Pairs collected by vessel are listed in [Table 1](#) by vessel code as defined in the 2016 IPHC survey manual (IPHC 2016a).

### Commercial Sampling Program

The COAC from the commercial fishery began in 2011. These otoliths are only collected from deliveries of Pacific halibut caught in regulatory areas where COAC sampling cannot be fully conducted on the setline survey. The number of otoliths targeted from commercial deliveries varies from year to year and depends on the availability of otoliths from the setline survey in a given regulatory area. In 2016, COAC samples from the commercial fishery were requested from Areas 2A, 4B, and 4CD, and 178, 154, and 40 otolith pairs were collected respectively from these

areas (Table 1). These otoliths were collected by samplers in Newport, OR, Bellingham, WA, and La Conner, WA (2A); Kodiak, AK and Dutch Harbor, AK (4B); and St. Paul, AK (4C). Sampling protocol and rates were established by port and regulatory area prior to the start of sampling in those ports (IPHC 2016b). In Bellingham, La Conner, Newport, Kodiak, and Dutch Harbor, most of the COAC samples were taken from the same deliveries sampled for age and length data to be used in the stock assessment, but a few came from deliveries not sampled for age determination. In St. Paul, the samplers collected COAC otoliths on days when commercial samples for the assessment were not being collected.

### NMFS trawl survey

The NMFS conducts an annual trawl survey in the Eastern Bering Sea and biennial surveys on alternate years in the Gulf of Alaska and Aleutian Islands. Due to the nature of the trawl survey, a large portion of the catch consists of small Pacific halibut that are not represented in the setline survey or commercial port sampling collections. COAC sampling took place on the NMFS trawl surveys between 2011 and 2014. Trawl survey COAC sampling was suspended for 2015 and 2016 in order to allow samplers to focus on a Pacific halibut tagging pilot project implemented on the trawl surveys in 2015 (Forsberg et al. 2016) and tagging and tissue sampling in 2016 (Ortiz 2017, Planas and Dykstra 2017). Although the IPHC expects to continue these projects over the next several years, samplers may resume COAC sampling as well on future trawl surveys.

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**Table 1. Number of COAC otoliths collected by regulatory area, vessel code, and collection type in 2016. Collection type: SS (setline survey) and CSP (commercial sampling program).**

Vessel Code	Collection Type	Regulatory Area									Total
		2A	2B	2C	3A	3B	4A	4B	4C	4D	
FTW	SS		49								
PEN	SS		59								
KSU	SS			61							
PEN	SS			28							
BDP	SS				37						
CLD	SS				42						
KSU	SS				9						
SEY	SS				11						
STN	SS				7						
ALL	SS					18					
CLD	SS					19					
FTW	SS					37					
POL	SS					44					
VNI	SS						90				
VNI	SS								5		
SNW	SS									14	
	CSP	178						154	40		
<b>Total</b>		178	108	89	106	118	90	154	45	14	<b>902</b>