

Sampling and Analysis

Commercial catch sampling

Lara M. Hutton, Tracee O. Geernaert and William G. Clark

Abstract

This paper describes the 2002 International Pacific Halibut Commission (IPHC) commercial catch sampling program for halibut in Alaska, British Columbia, Washington, Oregon, and California. Commercial catch sampling involves collecting otoliths, halibut lengths, logbook information, and final ticket weights. All of the collected data are used in stock assessment. Otoliths collected provide age composition. Lengths of sampled halibut provide growth and mean weight. Mean weights are combined with ticket weights to estimate catch in numbers. Copied logbook information provides catch per unit effort (CPUE) data, fishing location for the landed weight, and data for research projects. Finally, tags are collected to provide information on migration and mortality.

Fishery background

Individual Quota (IQ) systems remained in place in Alaska and British Columbia. The commercial fisheries off Washington, Oregon, and California (Area 2A) are allocated catch limits by the Pacific Fishery Management Council (PFMC). The Area 2A directed commercial fishery was restricted to waters south of Point Chehalis, Washington (46°53'18"N. latitude). The incidental halibut fishery during the sablefish season and the treaty Indian tribes' commercial fisheries were north of Point Chehalis.

Sampling objectives

The primary objective in sampling landings of commercially caught halibut is to have halibut samples represent the total commercial halibut removals. To accomplish this, random sampling techniques are applied and an equal proportion of the catch is sampled over the entire landing period, or season, using prescribed sampling rates. While sampling, other objectives include copying fishing logs and their respective ticket weights for as many halibut trips as possible throughout the entire season, and collecting tags.

Inherent in the sampling program is the positioning of field sampling staff in ports where there is an opportunity to sample a majority of the catch by weight for each regulatory area. To ensure that proportional sampling occurs, based on the weight landed by regulatory area per port, landing patterns are reviewed annually. To accomplish proportionality in 2002, different days were assigned for sampling in each port. In some cases, different sampling percentages were also assigned by port and by regulatory area. Finally, sampling priorities by regulatory area within a port were assigned.

For Area 2A, the sampler in Bellingham sampled the incidental halibut catch during the sablefish season at a rate of five percent, three days per week.

For Area 2B, the samplers in Vancouver and Prince Rupert sampled four days per week at one percent, while Port Hardy sampled four and a half days per week at one percent.

For Area 2C, Juneau, Petersburg, and Sitka samplers sampled five days per week. The Juneau and Petersburg samplers sampled at two and a half percent while the Sitka sampler sampled at three and a half percent. All other port samplers sampled Area 2C landings four days per week at two and a half percent. Sitka was sampled at a higher rate due to the large number of landings in that port and the inherent conflict of concurrent offloads.

For Area 3A, the sampler in Kodiak sampled three and a half days per week at one percent while samplers in all other ports sampled at three days per week at one percent, except Homer which sampled at two percent. Once again, differences in sampling rates were due to conflicts arising in ports with more poundage and landings.

For Area 3B, all samplers sampled five days per week. The sampler in Seward sampled at a rate of one percent while all other samplers sampled at one and a half percent.

For Areas 4A, 4B, 4C and 4D, all samplers sampled five days a week using four percent for Area 4A, six and a half percent for Area 4B, and four percent for Area 4C&D. There were a few exceptions to these sampling rates and days. One was the Area 4C Community Development Quota (CDQ) fishery in St. Paul, which is sampled from beginning to end and usually lasts about two months. The St. Paul sampler sampled Area 4C CDQ at three percent, five days a week. The Adak sampler (new in 2002) sampled 4B landings at five percent. The Dutch Harbor sampler was the final exception, sampling six days a week for all Area 4 fish and at a rate of three percent for Areas 4C and 4D.

Samplers use judgment when there are sampling conflicts. For example, it is common to have more than one boat at a time unloading from the same regulatory area. In these cases, the vessel with the larger poundage of halibut is usually sampled. In another instance, a sampler may be working at an unloading facility where there is a constant stream of halibut offloads. In this case, a sampler may opt to stay at the one location. Finally, there are conflicts between regulatory areas. Sampling priorities are assigned differently for these regulatory area conflicts. In Canada, when there is a choice of regulatory areas, Areas 2B and 2C are equal and are sampled before Areas 3A and 3B. In Alaskan ports, Area 4 is sampled first, followed sequentially by Area 2C, Area 3A, and Area 3B. Areas 3A and 3B are treated equally. Finally, there is a priority scheme for Area 4: Area 4B is sampled first, followed by Areas 4C and 4D, then by Area 4A.

The last objective involves otolith targets by regulatory areas. Otolith targets are established to optimize work effort and sample size. A target of 2,000 otoliths with halibut lengths (plus or minus 500) was set for each of Regulatory Areas 2B, 2C, 3A, 3B, 4A, 4B, and Areas 4C and 4D combined in 2002. In Area 2A, the target was 1,000 otoliths with their corresponding lengths. The Area 2A target was further subdivided to obtain a proportional sample based on the treaty Indian and directed commercial catch limits. This resulted in a target of 650 otoliths/lengths for the treaty Indian fishery and 350 otoliths/lengths for the non-treaty directed commercial fishery.

Sampling rate calculations

Sampling rate calculations for each regulatory area are shown in Tables 1 and 2. The rates were calculated by determining the average halibut weight for an area using Forsberg (2002) and multiplying the weight by the otolith target for each respective area to obtain a sample size. This sample

size was divided by the available catch limit set by IPHC to obtain the overall percentage to be sampled. This sampling percentage was divided by the proportion of the catch expected to be landed in ports with samplers in place, to obtain a sampling ratio for sampled ports. This resultant ratio was then divided by an estimate of landings that will actually be sampled to obtain the sampling rate for each area. This rate was rounded to the nearest 0.5% with 1% as a minimum rate. As a comparison to the estimates, the actual average halibut weight and the actual ratio landed in sampled ports is included.

Alaskan IFQ

To meet Alaskan sampling objectives, the ports of Dutch Harbor, Homer, Kodiak, Seward, Juneau, Sitka, Petersburg, and Bellingham were staffed. Adak was staffed from June 1st through till August 15th in 2002. St. Paul was staffed during the Area 4C CDQ fishery from June 15th through August 31st. Lastly, halibut landings from Alaska unloaded in Prince Rupert were sampled. A sampling summary is presented in Table 3. Otolith/length samples for each Alaskan regulatory area fell within an acceptable range. In 2002, a high volume of halibut was landed in Dutch Harbor leading to more sampling conflicts where offloads occurred simultaneously. Further, one buyer location could not be sampled. As in 2001, a large number of landings were made into Adak in 2002, validating the addition of the new Adak port sampler.

The goal of having sampled weight proportional to landed weight in each sampled port was met acceptably (Table 4). The variation among ports was less than it had been in 2000 and 2001. The reason for this appears to be related to the return of regulatory area information on the Prior Notice of Landing (PNOL). The PNOL is compiled from Restricted Access Management (RAM) data of vessels notifying NMFS Enforcement of their intention to land. It includes poundage of halibut and sablefish, the unloading port, the buyer, and the unloading date and time. The Regulatory Area was omitted from the Pending Landing List in 2000 due to a regulatory omission, but was reinstated in 2002. The advanced knowledge of which regulatory area the catch is from helps samplers set sampling priorities.

IPHC samplers collected about 4,000 Alaskan logs from ports where we have a presence and another 200 logs for Alaskan landings from other ports. Samplers have an opportunity to collect logs from other locations when they encounter transient halibut vessels in their own ports. Samplers also collected 58 tags. Table 5 illustrates fishing logs collected in key ports.

Canadian IVQ

IPHC samplers were in place in Prince Rupert, Port Hardy, and Vancouver, where about 88% of the total Area 2B catch was landed. About 44% of the coast-wide Area 2B poundage was sampled and 2,526 otoliths were collected. Canadian samplers collected 821 Canadian logs in their ports. A total of 55 U.S. logs were also obtained in Bellingham and Prince Rupert by the local samplers (Table 5). Data from tagged halibut were also collected. There were only 2 halibut tags recovered in 2002. This does not include the sport charter catch and release program.

Washington, Oregon and California

Treaty Indian managers worked cooperatively with IPHC and sampled the Area 2A-1 catch, meeting the sampling objective of 650 otoliths. There were 816 fish sampled in the tribal fishery.

The Area 2A non-treaty commercial sampling was conducted only in Newport, Oregon, where sampling objectives were met. To insure this, all of the three openings were sampled with extra samplers. Both options (extra samplers and all openings sampled) significantly improved Area 2A non-treaty commercial fishery sampling efforts.

References

Forsberg, J. E. 2002. Age distribution of the commercial halibut catch for 2001. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2001: 113-118.

Table 1. 2002 otolith targets and sampling rates for Areas 2B, 2C, 3A and 3B.

	Regulatory Areas			
	2B	2C	3A	3B
Otolith target (no)	2,000	2,000	2,000	2,000
2001 Average halibut weight (lbs)	23.7	29.4	27.2	25.3
Sample size (000 lbs)	47.4	58.8	54.4	50.6
Catch limit (000 lbs)	11,750	8,500	22,630	17,130
Overall percentage to be sampled	0.004	0.007	0.002	0.003
Proportion landing in sampled ports	0.89	0.64	0.81	0.85
Ratio for sampled ports	0.005	0.011	0.003	0.003
Estimate that will be sampled	0.46	0.43	0.27	0.22
Final sampling rates (%)	1.0	2.5	1.0	1.5
Actual average halibut weight (lbs)	23.5	34.3	26.3	24.8
Actual ratio landing in sampled ports	0.88	0.61	0.83	0.78

Table 2. 2002 otolith targets and sampling rates for Areas 2A-1, 2A, 4A, 4B and 4C&D.

	Regulatory Areas				
	2A-1	2A	4A	4B	4C&D*
Otolith target (no.)	650	350	2,000	2,000	2,000
2001 Average halibut weight (lbs)	25.2	27.7	29.1	29.2	32.6
Sample size (000 lbs)	16.4	9.7	58.2	58.4	65.2
Catch limit (000 lbs)	468	223	4,970	3,344	4,060
Overall percentage to be sampled	0.035	0.043	0.012	0.030	0.029
Proportion landing in sampled ports	0.91	0.35	0.97	0.98	0.91
Sampling ratio for sampled ports	0.038	0.124	0.012	0.018	0.018
Estimate that will be sampled	0.70	0.35	0.39	0.53	0.60
Final sampling rates (%)	5.0	35.0	4.0	6.0	3.0
Actual average halibut weight (lbs)	23.8	27.0	32.1	31.8	31.8
Actual ratio landing in sampled ports	0.76	0.69	0.96	0.98	0.78

*4C&D includes CDQ

Table 3. Summary of 2002 otolith targets, collected otoliths, vessels sampled and the percentage of the catch sampled.

Regulatory Area	Otolith Target	Collected Otoliths	No. Landings Sampled	% of Catch Sampled-lbs
2A-1	650	816	33	13
2A	350	719	48	39
2B	2,000	2,526	298	44
2C	2,000	2,022	165	28
3A	2,000	2,653	187	23
3B	2,000	1,967	93	20
4A	2,000	2,861	83	45
4B	2,000	2,903	53	45
4C&D	2,000	1,648	80	52
Totals	15,000	18,115	1040	30

Table 4. Proportion of halibut landings sampled, by weight, separated by IPHC regulatory area and listed by key ports.

Port	2A	2B	2C	3A	3B	4A	4B	4C&D
Newport	0.62							
Taholah	N/A							
La Push	N/A							
Neah Bay	N/A							
Vanc/Bell	0.72	0.59	0.72	0.34	0.20			
Port Hardy		0.48						
Prince Rupert		0.48	0.47					
Petersburg			0.43	0.52				
Sitka			0.51	0.39				
Juneau			0.38	0.22				
Seward			0.77	0.33	0.40	1.00		1.00
Homer				0.19	0.26	0.72	0.92	0.37
Kodiak				0.27	0.20	0.20		
Dutch Harbor					0.15	0.43	0.47	0.82
Adak						0.05	0.43	
St. Paul								0.70

Table 5. The number of halibut fishing logs collected for key ports.

Port	US	Canada	Total
Newport	65		65
Taholah	N/A		
Neah Bay	N/A		
Bellingham	54		54
Port Hardy		333	333
Prince Rupert	3	403	406
Vancouver		85	85
Petersburg	368		368
Sitka	447		447
Juneau	219		219
Seward	405		405
Homer	697		697
Kodiak	536		536
Dutch Harbor	323		323
St. Paul	515		515
Adak	80		80
Total key ports	3,712	821	4,533
Total all ports	3,999	904	4,903

Age distribution of the commercial halibut catch for 2002

Joan E. Forsberg and Calvin L. Blood

Abstract

The age distribution of halibut sampled from the 2002 commercial catch is summarized. In addition, proposed increases in the number of break-and-burn readings and their implications in terms of increased aging workload are discussed.

Age distribution

The age distribution of the commercial catch of Pacific halibut is summarized in Table 1. Mean age of halibut by regulatory area for the years 1993-2002 is presented in Table 2. Average age of samples in Areas 2A, 2C, 3, 4B, and 4C increased from 2001, while average age decreased in Areas 2B, 4A, and 4D. The average age from all areas combined increased by 0.4 years in 2002. Overall average age in 2002 was two years higher than it was in 1993.

Average size (measured fork length) of sampled halibut increased in Areas 2C, 4A, and 4B in 2002 but decreased in Areas 2A, 2B, 3, 4C, and 4D. Average fork length for all areas combined increased slightly from 2001.

The 1988 year class (14-year-olds) accounted for the largest proportion (in numbers) of the overall commercial catch (16%) in 2002. The next most abundant year classes were 1987 and 1989, (15- and 13-year olds), accounting for 13% and 11% of the catch respectively. Fourteen-year-olds were also the most abundant year class in Regulatory Areas 2, 3, and 4B. The 1987 year class (15-year-olds) was the most abundant in Regulatory Areas 4A, C, and D and the second most abundant in Areas 2C, 3, and 4B. Fourteen-year-olds were the second most abundant year class in Areas 4A, C, and D while 13-year-olds (1989 year class) were the second most abundant year class in Areas 2A and B.

The youngest and oldest halibut in the 2002 commercial or “market” samples were determined to be three and 50-years old, respectively. There was one 3-year-old, which was captured in Area 2C measuring 91 cm and was noted as having a small otolith. The 50-year-old came from Area 4B, and had a fork length of 104 cm. The largest halibut in the 2002 commercial samples was a 209-cm fish from Area 4A, which was determined to be 21 years old.

Table 3 contains percent agreement values for quality control (QC) readings. In 2001, ages for which between-reader discrepancy was two years or greater were resolved by the reader and tester using a microscope with dual eyepieces (discussion tube). Resolved ages were not entered. In 2003, we will add fields for additional ages (Surface 1 and 2; Burn 1 and 2; and Resolved) which will be entered.

The peak months for aging in 2002 were August, September, and October (Fig. 1). August was the busiest month for “priority area” (Areas 2 and 3A) setline survey otoliths, while the busiest month for aging commercial samples was October. Ages for priority area samples were used for the

stock assessment and had to be complete and entered by October 15th. In 2001, August was the peak month for both priority area survey and market sample otoliths. In 2002, priority area survey otoliths were not available until late July or August. Availability of survey otoliths for aging depends on the schedules of the survey vessels, which can vary from year to year.

In 2002, over 18,000 market sample otoliths had been collected at the time of writing, more than have been collected since the mid-1980s. The target sample size for the market sample collection is 2000 otoliths for each of Regulatory Areas 2B, 2C, 3A, 3B, 4A, and 4B, 2000 otoliths for Areas 4C and 4D combined, and 1000 otoliths for Area 2A. Significant oversampling of the commercial catch occurred in Areas 2A, 2B, 3A, 4A, and 4B in 2002.

For the first time in six years, the strong 1987 year class was not the most abundant (in numbers) in the overall commercial catch. However, in 2002 age readers began breaking and burning all otoliths with a surface age of 15 years and older. Halibut surface aged as 15-year-olds (1987 year-class) accounted for the largest proportion of the commercial catch, at 18.5% (Table 4). Some of the shifts in relative proportions of age classes in the 2002 commercial age distribution could be due to establishing a rule for breaking and burning all otoliths with surface age 15 and up.

Changes to aging criteria in 2002

Halibut ages are determined by counting the annual growth zones of otoliths. A year's growth consists of both an opaque and translucent zone. The opaque zone is formed during the period of faster growth, which typically occurs in the summer. The translucent zone is formed during slower growth, which typically occurs in the winter. The opaque and translucent zones are also often referred to as the summer and winter zones respectively. Surface reading of otoliths has been the aging standard at the International Pacific Halibut Commission (IPHC) since the 1920s (Forsberg 2001). The otolith is viewed distal surface up and the narrow winter zones (annuli) between the nucleus and the edge are counted to determine the age in years.

In 1992, readers began to perform break-and-burn readings on a portion of otoliths meeting certain criteria. Since deposition on the various surfaces of the otolith changes as the fish grows older, some annuli may not be visible from the distal surface. Viewing the otolith in cross-section allows viewing of such "hidden" annuli that may only be visible on the proximal surface. "Burn-ing" increases the contrast between the opaque and translucent zones; the opaque zones turn light brown while the translucent zones turn dark brown when heated.

The criteria for using the break-and-burn technique have been modified over the years and this, along with changes in otolith growth rate and corresponding patterns, has led to increasing numbers of break-and-burn age readings. Criteria for performing a break-and-burn reading include: high surface age, thick otolith, steep edges, difficult surface pattern, poor clearing, discrepancy in readings between different sites on the otolith, discrepancy in age readings between readers, and choice surface-reading site damaged or missing.

Initial analysis of a comparison of surface and burn ages indicated a divergence between surface and burn ages at surface age 15 (Blood, Calvin P.O. Box 95009, Seattle, WA 98145, pers. comm.) and Blood recommended breaking-and-burning all otoliths with surface age 15 and older. In another study in 2001, replicate readings of burnt sections were found to be less variable than replicate surface readings of the same otoliths for surface age 12 and greater (Forsberg et al. 2002). Further analysis of the surface-burn age comparison indicated the "cutoff" surface age for performing break-and-burn should be even lower, between seven and 10 years (Blood, in press).

As most age discrepancies of two years or greater came from fish surface aged 15 or older in 2001, the cutoff age for break-and-burn was set at 15 for 2002. Breaking-and-burning everything over surface age 14 resulted in about a three-month increase in the aging workload. Preparing and reading a burnt otolith section takes at least twice as long as making a surface reading. Breaking-and-burning all otoliths older than either seven or 10 as Blood's latest results indicated would result in an estimated increase of between 15,000 and 20,000 readings by break-and-burn, or about eight to 10 months of additional full-time aging (assuming a rate of 2000 break-and-burn ages per month). Aging all halibut by the break-and-burn technique is also being considered (Clark and Hare 2003). Burning all otoliths would add an extra 2,000 or so otoliths, mostly from the setline and trawl survey collection (general series, or "GS"), to the aging workload, which would equate to another month's worth of full-time aging.

To address the increase in age 20 and older halibut in the assessment coincident with setting the break-and-burn cutoff at surface age 15 in 2002, Clark and Hare (2003) propose re-aging otoliths from prior years. Otoliths that were previously only surface-aged will be re-aged with the break-and-burn technique. This will be a very time consuming project, since it will involve removing the otoliths from storage vials in addition to breaking, burning, and aging.

References

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Table 1. Age distribution of commercial catch of Pacific halibut by regulatory area, 2002.

	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4A	Area 4B	Area 4C	Area 4D	All Areas Combined
Age	% of catch	% of catch	% of catch	% of catch	% of catch	% of catch	% of catch	% of catch	% of catch	% of catch
3	0	0	0.1	0	0	0	0	0	0	<0.1
4	0	0	0	0	0	0	0	0	0	0
5	0	0.1	0.1	0	0	0	0	0	0	<0.1
6	0	0.9	1.0	0.1	0.1	0.1	0	0	0.2	0.3
7	0.5	3.6	1.6	0.4	0.6	1.9	0.3	0.6	0	1.2
8	2.6	7.7	4.4	1.0	3.0	5.0	1.3	6.5	1.9	3.7
9	4.1	6.4	4.5	1.5	3.1	3.7	4.7	5.0	2.1	4.0
10	8.1	8.1	6.8	2.6	4.8	7.5	9.0	8.5	2.1	6.7
11	11.2	9.1	7.2	3.9	7.7	7.8	4.4	6.8	4.2	6.9
12	12.4	9.9	9.4	6.7	8.9	7.9	6.4	8.1	7.2	8.4
13	14.7	12.8	12.8	9.9	11.2	10.4	8.7	12.4	11.3	11.3
14	18.2	15.0	19.6	17.4	15.7	14.3	13.3	14.1	17.7	15.9
15	12.7	9.7	13.0	12.0	11.2	15.4	9.3	19.6	21.9	12.6
16	6.0	5.3	7.0	9.5	7.2	6.8	7.4	5.5	8.1	7.1
17	2.6	2.9	3.9	7.0	3.7	3.3	3.1	2.9	3.5	3.8
18	2.3	2.3	2.5	7.0	4.4	2.4	3.6	1.2	3.4	3.4
19	1.3	1.9	1.4	5.9	4.4	2.3	4.8	0.8	2.7	3.1
20	0.9	0.9	1.1	4.2	3.3	1.6	3.5	0.7	2.5	2.2
21	0.5	0.9	0.9	3.3	2.7	1.5	3.3	1.0	0.7	1.9
22	0.6	0.7	0.7	2.4	2.2	1.4	3.6	1.1	2.7	1.8
23	0.5	0.4	0.7	1.8	1.7	2.2	2.5	1.8	3.0	1.6
24	0.3	0.5	0.5	1.2	0.8	1.1	3.0	1.6	1.9	1.2
25	0.3	0.2	0.6	0.8	1.2	1.5	1.6	0.9	1.2	0.9
26+	0.2	0.7	0.6	1.5	2.1	1.9	6.1	0.8	1.6	2.0

	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4A	Area 4B	Area 4C	Area 4D	All Areas
Average Length (cm)	102.3	100.0	112.0	104.7	102.9	110.0	110.0	107.8	111.9	106.6
Average Age (years)	13.3	12.8	13.5	15.7	14.9	14.2	16.1	13.7	15.3	14.5
Average Weight (lbs) ¹	23.8	23.5	34.3	26.2	25.0	31.8	31.7	30.2	32.3	28.7
Otoliths Collected ²	1,544	2,526	2,022	2,631	1,967	2,861	2,903	908	689	18,051
Otoliths used in stats ³	1,506	2,227	1,967	2,460	1,692	2,676	2,619	886	566	16,599

¹Weights calculated from measured fork lengths

²Summarized from market sample forms entered by November 25, 2002. This number is higher than the number of otoliths that will be aged since the "Otos Collected" figure may incorporate counting errors and includes otoliths that are discarded and not aged

³Numbers of otoliths aged by November 25, 2002

Table 2. Mean age (in years) of Pacific halibut by regulatory area, 1993-2002.

Area	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2A	10.8	11.4	10.5	9.6	10.3	10.6	11.3	12.1	12.5	13.3
2B	11.9	12.4	11.9	11.6	11.3	11.8	12.6	12.5	12.7	12.8
2C	13.3	13.1	12.8	12.2	12.1	12.3	12.8	13.1	12.9	13.5
3A	12.8	13.3	13.0	13.0	13.2	13.7	14.1	14.5	14.9	15.7
3B	12.6	12.4	12.4	12.9	12.8	13.5	14.2	14.3	14.7	14.9
4A	12.2	11.6	13.6	13.0	12.8	12.5	12.9	13.8	14.5	14.2
4B	14.5	13.8	14.6	14.0	14.7	14.2	15.1	15.3	16.0	16.1
4C	11.9	12.1	11.8	10.7	11.5	11.7	12.3	13.4	13.6	13.7
4D	12.6	13.8	12.9	13.4	12.1	12.7	12.5	13.9	16.0	15.3
All Areas	12.5	12.7	12.6	12.3	12.5	12.6	13.3	13.7	14.1	14.5

Table 3. Between-reader percent agreement for market sample ages 1993-2001.

Year	Tot. aged	No. aged 2X	% agreement	Coeff. of Var.	Avg. % error	% - bias	% +bias
1993	13,747	2,752	60.0	2.8	2.0	12.6	27.4
1996	13,452	1,839	66.5	2.8	2.0	12.3	21.2
1997	15,500	2,203	65.4	2.4	1.7	17.0	17.7
1998	14,395	2,110	63.6	2.6	1.8	16.2	20.3
1999	12,796	1,117	63.4	2.5	1.8	16.2	20.4
2000	13,982	1,002	58.8	3.0	2.1	21.9	19.4
2001	13,181	2,025	45.2	3.9	2.8	29.7	25.1

Note: No QC readings were made for market sample otoliths in 1994 and 1995

Table 4. Relative numbers of otoliths aged 15 by surface and burn for 2001 and 2002 commercial samples.

Year	2001	2002
No. otoliths surface-aged 15	1,287	3,070
No. surface-aged 15 that were broken and burned	493 (38%)	3,052 (99%)
No. surface age=15 and burn age=15	119 (24%)	1,609 (53%)
No. surface age=15 and burn age>15	319 (65%)	1,076 (35%)
No. surface age=15 and burn age<15	55 (11%)	367 (12%)
Total no. otoliths with burn age=15	249	2,077
Total otoliths aged	13,181	16,599

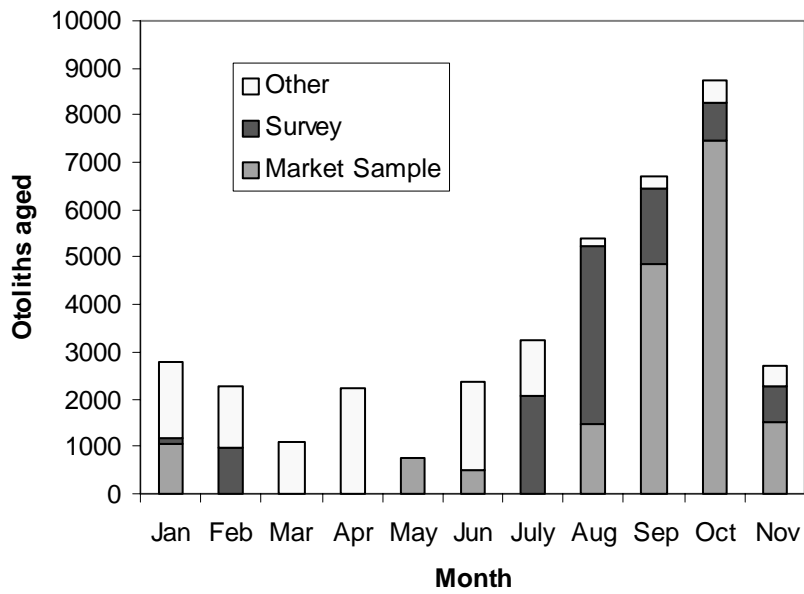


Figure 1. Aging workload January through November of 2002. “Other” category includes otoliths for research projects, reference set otoliths, and quality control ages.