The diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Strait of Georgia, 2000-2017

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ABSTRACT

Neville, C.M., Fitzpatrick, L.C., and Beamish, R.J. 2023. The diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Strait of Georgia, 2000-2017. Can. Tech. Rep. Fish. Aquat. Sci. 3525: vii + 22 p.

Diets of juvenile Chinook salmon during their first summer and fall in the Strait of Georgia, British Columbia, Canada are summarized for studies from 2000 - 2017. Approximately 21,000 juvenile Chinook salmon were sampled with all analyses conducted by the same expert and most analyses completed on fresh samples during the surveys. Comparison across the 18 years showed that juvenile Chinook salmon had a very consistent diet with four items representing over 90% of all stomach contents. An exception was in 2007 when there was a failure in the year class of Pacific herring. There was a relatively small proportion of empty stomachs in all years and these empty stomachs were observed across size classes.

RÉSUMÉ

Neville, C.M., Fitzpatrick, L.C. and Beamish, R.J. 2023. The diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Strait of Georgia, 2000-2017. Can. Tech. Rep. Fish. Aquat. Sci. 3525: vii + 22 p.

Les régimes alimentaires des saumons chinooks juvéniles au cours de leur premier été et automne dans le détroit de Georgia, en Colombie-Britannique, au Canada, sont résumés aux fins d'études de 2000 à 2017. Environ 21 000 saumons chinooks juvéniles ont été échantillonnés, toutes les analyses ont été effectuées par le même spécialiste et la plupart des analyses ont été réalisées sur des échantillons frais dans le cadre des relevés. La comparaison entre les 18 années a révélé que les saumons chinooks juvéniles ont un régime alimentaire très cohérent, avec quatre éléments représentant plus de 90% de tous les contenus stomacaux. Une exception a été observée en 2007, année où il y a un échec dans la classe d'âge des harengs du Pacifique. Il y avait une proportion relativement faible d'estomacs vides au cours de toutes les années et ces estomacs vides ont été observés dans toutes les catégories de taille de poissons.

1 INTRODUCTION

A study of the ocean ecology of juvenile Pacific salmon (*Oncorhynchus* spp.) in the Strait of Georgia on the south coast of British Columbia (B.C.), using a modified commercial mid-water trawl was initiated in the late 1990s (Beamish et al. 2000; Sweeting et al. 2003). These surveys were conducted annually in the early summer and the early fall. The primary objectives were to determine the early marine abundance, distribution and diet of juvenile Pacific salmon, and to identify factors that may be regulating growth and survival during their marine residence. The timing of the surveys was designed to focus on the ocean entry times of Chinook (*O. tshawytscha)* and coho (*O. kisutch*) salmon. However, all species of Pacific salmon as well as other fish species captured in the trawl were sampled. This report summarizes observations of the stomach contents of juvenile Chinook salmon captured in the survey area (standard track line) within the Strait of Georgia over the study period 2000-2017.

2 METHODS

2.1 Survey area and design

Surveys were conducted annually in summer (mid-June to mid-July) and fall (early September to mid October) from 2000 to 2017 for juvenile Pacific salmon following a standard track line in the Strait of Georgia and using protocols described in Beamish et al. (2000) and Sweeting et al. (2003). This standard track line covered the nearshore (> 80 m) and mid-water regions of the Strait of Georgia from Cape Mudge on the southern point of Quadra Island to the Canada / United States (U.S.) border in the southern Strait of Georgia (Fig. 1, standard track line). Additional areas, including Queen Charlotte Strait, Johnstone Strait, Desolation Sound, Bute Inlet, Jervis Inlet, Howe Sound, the Gulf Islands, and the U.S. waters of Puget Sound and Juan de Fuca Strait (Fig. 1), were fished during some of the surveys. However, fishing in these additional areas was not consistent between surveys and were not included in this report.

The specific dates of the summer and fall surveys in each year varied slightly depending on vessel scheduling but typically fell within a five-week time period (Table 1). The fishing platform was primarily the 58 m long Canadian Coast Guard vessel *W.E. Ricker*. For eight surveys the *W.E. Ricker* was not available, and the surveys were conducted with chartered commercial trawlers (Table 1); however, the fishing gear and protocols were consistent among vessels. In 2003 there was no survey in summer due to the lack of availability of either Canadian Coast Guard or charter vessels.

2.2 Catch and stomach contents processing

Juvenile Chinook salmon presented in this report are considered to be fish in their first ocean year. We classified these as fish with a fork length ≤ 303 mm. This size range represented about 97% of all Chinook salmon caught in the standard track line sets, and by having an upper size limit for age classification, eliminated the need to age the larger fish.

The protocols for processing catch are available in Beamish et al. (2000) and Sweeting et al. (2003). The fish sampled were measured for fork length (mm) and weight (g). Stomach sampling of juvenile Chinook salmon followed the process described in Neville and Beamish (1999) and Sweeting and Beamish (2009). The stomach contents were identified by Carol Cooper (Zotec Services, Nanaimo, B.C.), an expert in zooplankton and larval fish taxonomy, and in diet analysis of pelagic fishes. Almost all of the analyses were conducted at sea on fresh stomach contents and typically within 30-60 min of capture. A small number of stomachs (~1%) from the years 2016 and 2017 were identified from preserved (in 95% ethanol) or frozen stomachs.

The stomach of each fish was removed from the gill arch to the anterior of the small intestine. The percent fullness of the stomach was estimated prior to emptying contents into a petri dish. The volume of the total stomach contents and the percent digestion were visually estimated by the expert conducting the analysis. However, volumetric flasks were used to verify volume as required. For percent digestion, prey items that had a similar level of digestion were considered to result from one feeding. When multiple feedings were in the stomach, the average digestion of all contents was recorded. The contents in the stomach were identified and recorded to the lowest taxonomic level possible using a hand lens with 10 times magnification. The proportion of each prey category by volume was estimated and recorded as a percentage of the total stomach contents. The stomachs were classified as empty when the estimated volume of material was < 0.1 cc.

In this report, the stomach contents were summarized by grouping the identified contents into five categories: “fishes”, “decapods”, “euphausiids”, “amphipods” and “other” (Table 2). The fishes category included 16 different species or families (Table 2). Additionally, this group included fish remains that could not be classified due to digestion. The decapod category included crab, shrimp, copepods, mysids, barnacles and ostracods; and the highest classification was to family (Table 2). Euphausiids were grouped together as information on species was inconsistently collected across the study years. The amphipods category included three families: hyperiids, gammarids and caprellids (Table 2). The “other” category included prey items that were not listed in one of the first four categories, as well as items that were too digested to identify. A complete list of prey types in each category can be found in Table 2 and the individual species or groups within the prey category are ranked in order of overall importance for both the summer and fall surveys. This ranking was based on the total average volume of the prey category for each summer and fall survey. The total volume of each prey category as a proportion of the total volume was calculated for each survey. Additionally, the proportion of empty stomachs in the sample was reported for each survey.

2.3 Comparisons and trends

Changes in the size of the juvenile Chinook salmon caught over the 18-year study period and between fish caught in the surface waters or at depth (< 30 m or ≥ 30 m) were examined using a Mann-Whitney U test. The trends or differences in the juvenile Chinook salmon diet over the 18 year study period, between fish caught in summer and fall surveys and between fish caught in the surface waters and deeper waters were noted.

3 RESULTS

3.1 Summer surveys

There were 10,705 Chinook salmon stomachs examined for the summer surveys with an average of 630 examined each year (Table 3, Fig. 2). The average fork length of juvenile fish in the summer surveys was 141 mm ± 31.0 SD, ranging annually from 116 mm in 2007 to 154 mm in 2001 (Table 4, Fig. 3). The fish captured in 2007 were significantly smaller than during the other years ($p < 0.00$). The largest fish were caught during the summers of 2000, 2001, 2011, 2012, 2015 and 2016 ($p < 0.00$). The percent of empty stomachs in the summer surveys ranged from 11.5-28.6%, with an average of 17.3% ± 5.8 SD (Table 3, Fig. 2). The largest proportion of empty stomachs was in 2007, followed by 2015 and 2016. The lowest proportion of empty stomachs (less than 15%) was observed in the years prior to 2007 and in 2011 to 2013. Fish with empty stomachs were found across all the size ranges of fish sampled (Fig. 3).

In the summer surveys, the average volume of prey items in stomachs was 0.9 cc and ranged from 0.4 to 1.7 cc (Table 3). Diet was primarily comprised of fishes (62%) with this category representing over 50% of the diet in all but four years (Table 3, Fig. 4). Pacific herring were the dominant species in this category, representing about 61% of all fishes (Table 2). There were four years that this dominance of fishes, especially Pacific herring, was not observed. In 2005 and 2007 there were no Pacific herring observed in the diet. In 2005, the fishes category comprised 48% of the diet but were identified as juvenile smelt and rockfish. In 2007 this switch to other fish species did not occur and the fishes category declined to only 9% of the diet, primarily unidentified larval fish and fish remains. Declines in the proportion of fishes were also observed in 2010 and 2014. In these years, similar to 2005, the fishes category remained important (38-46%; Table 3, Fig. 4) but there was increased variability in the types of fish species identified, with increases in Pacific sand lance, juvenile rockfish, and larval fish.

Decapods were the second most common prey category in the summer (average 16%; Table 3). There was variability between years from 6% in 2002 and 2011-2012 to 45% in 2007. Larval crab (megalops and zoea) represented 89% of the decapods category and was dominant in every year. The third most important prey category in the summer was amphipods. This category represented, on average 11% of the stomach contents with a low of 2% in 2006 and a high of 24% in 2007 (Table 3). Amphipods ranked in the top three most common prey categories for twelve of the seventeen years. Hyperiid amphipods were the dominant family and represented about 98% of this category in every survey. Euphausiids, represented, on average, only 8% of the stomach contents. In three years (2002, 2014, 2016) this category represented more than 15% of the stomach contents (Table 3).

The “other” category accounted for about 3% of the total diet in the summer surveys and included seven species or groups as well as contents that were too digested for identification (Tables 2-3). In the summer of most years, this category was dominated by juvenile octopus (58%). Three exceptions were in 2000 and 2010 when a higher proportion of squid was observed, and in 2002 when a higher proportion of arrow worms (chaetognaths) was observed.

3.2 Fall surveys

There were a total of 10,943 Chinook salmon stomachs examined for the fall surveys with an average of 608 examined each year (Table 5, Fig. 2). The average length in the fall surveys was 173 mm ± 44.9 SD, ranging annually from 139 mm in 2008 to 196 mm in 2001 and 2013 (Table 6, Fig. 5). The fish captured in 2008 were significantly smaller than in other years ($p < 0.00$). The fish caught in the fall of 2001, 2013, 2015 and 2016 were larger than in other years ($p > 0.01$). The percent of empty stomachs in the fall surveys ranged from 5.2-26.4%, with an average of 16.0% ± 7.0 SD (Table 5, Fig. 2). The years with the highest proportion of empty stomachs were 2000-2001 and 2015-2016. In these years the percent of empty stomachs exceeded 24%. The years with the lowest proportion of empty stomachs (≤ 10%) were 2005, 2007, 2009, 2010 and 2017. Fish with empty stomachs were found across all the size ranges of fish sampled in the fall surveys (Fig. 5).

In the fall surveys, the average volume of prey items in stomachs was 1.2 cc and ranged from 0.7 to 2.1 cc (Table 5). The fishes and amphipods categories were the most important prey categories by volume in the fall surveys and combined to represent, on average, 67% of the diet (Table 5). In all but two years, one of these two categories was the most common diet category by volume. The exceptions were in 2013 and 2014 when euphausiids were the most common prey category (Table 5). The fishes category comprised from 7% of the diet in 2007 to 78% of the diet in 2006 (average 39%). Pacific herring was the most common species in this prey category, representing, on average, 71%. There were exceptions in 2005 and 2007 when no Pacific herring were observed in the diets. In 2005 smelts and juvenile walleye pollock represented half of the diet classified as fishes. In 2007 the proportion of fishes in the diet was the lowest in the time series and the small amount that was present was mostly unidentified smelts and larval fish. The amphipods category comprised, on average, 28% of the stomach contents but ranged from 5% in 2006 to 56% in 2007 (Table 5). Hyperiid amphipods represented about 95% of this category and were dominant in every year. Overall, by volume, euphausiids were the third most common diet category in the fall and represented about 18% of the stomach contents. Similar to the fishes and amphipods categories, there was high variability across years from 5% in 2006 to 42% in 2014 (Table 5, Fig. 5). Decapods accounted for, on average, only 8% of the stomach contents in the fall with a range of 2-20% by volume (Table 4). The years 2007 and 2010 were exceptions when decapods represented over 15% of the diet. Larval crab remained the dominant decapod (average 72%) in most years. Exceptions were in 2004 and 2016 when shrimp was dominant (78% and 68%, respectively) and larval crab represented less than 15%.

The “other” prey category represented about 6% on average of the diet in the fall (Table 5, Fig. 5) and included nine species or groups in addition to digested matter (Table 2). Octopus and squid (average of 23% and 14%, respectively) dominated this category in half of the survey years and, with the exception of 2002 and 2014, were both consistently in the top three items by volume in this category. Other diet items, including pteropods (18.4%), gastropods (14.4%), insects (11.8%), and polychaetes (7.6%), were also common and in some years were some of the most common prey types in the “other” category (pteropods: 2010, 2014, 2015; gastropods: 2002, 2009; insects: 2007, 2011; and polychaetes: 2013).

4 COMPARISONS AND TRENDS

4.1 Summer vs fall surveys

The dominant prey categories in the summer surveys, in order of importance, were fishes, decapods and amphipods, representing, on average 89% of the stomach contents. In the fall surveys, three prey categories also represented the majority of diet (85%) but were, in order of importance, fishes, amphipods and euphausiids. The combined prevalence of the top four categories represented 97% of the diet of juvenile Chinook salmon in the summer and 94% of the diet of juvenile Chinook salmon in the fall.

The proportion of the fishes category by volume declined from an average of 62% in the summer to 39% in the fall. However, due to increased variability in the volume of fish found in stomachs from the fall surveys, this decline was not consistent across years and in some years (2000, 2006, 2016) the proportion of fishes in the diet in the fall increased (Table 5). A consistent species within the fishes category was Pacific herring, which ranked generally as most common by volume in both the summer and fall surveys. The only exceptions were in 2005 and 2007 when Pacific herring were absent in the diet.

The average proportion of amphipods in the diet increased from 11% in the summer to 28% in the fall surveys and was the most common prey category in six of the fall survey years (Table 5). Similarly, the proportion of euphausiids increased in the diet from an average of 8% in the summer to 18% in the fall. Although there was an increase in all years, the greatest increases were in the 2013 and 2014 fall surveys. In these two years euphausiids were the most important prey category by volume in the fall.

In contrast to amphipods and euphausiids, the proportion of the decapods in the diet declined from summer (16%) to fall (8%) in all years except 2011. There were two years with larger than average proportions of decapods in the diet (2007 and 2010) and this trend was consistent in both the summer and fall surveys (Tables 3, 5).

There was more diversity and a higher representation of the “other” category in the diets from fall surveys when compared to the summer surveys (Table 2). Octopus and squid remained important in this category for both surveys. However, in the fall surveys, similar proportions of gastropods and pteropods were observed which had been generally absent in the summer surveys.

The variation in diet between summer and fall surveys may be due to different size or stock compositions of juvenile Chinook salmon populations in the Strait of Georgia during these seasonal time periods (Beamish et al. 2010). Juvenile Chinook salmon that originate from the South Thompson region of the Fraser River (Fig. 1), enter the ocean in late June/early July, several months after most other juvenile Chinook salmon. In the fall, these South Thompson origin Chinook salmon are the dominant stock caught in the juvenile salmon surveys and are typically smaller than the earlier ocean entrants.

4.2 Comparison by depth strata

A total of 9,144 stomachs were examined from Chinook salmon captured in the surface waters (< 30 m) and 1,561 stomachs from Chinook captured in deeper waters (≥ 30 m) during the summer surveys (Table 7). In the fall surveys, 8,298 stomachs were examined from Chinook salmon captured in the surface waters (< 30 m) and 2,645 stomachs from Chinook salmon captured in deeper waters (≥ 30 m; Table 8).

Comparisons of the average length of fish caught in surface waters with those caught in deeper waters found significant differences in the length for all years/seasons except during the summers of 2011, 2012, and 2017, and during the falls of 2001 and 2006 ($p < 0.05$; Table 9). Even though there were significant differences in the size of fish in the summer surveys at the two depths in all but three years (Table 9), there were only small differences in the diet of Chinook salmon caught at these two depth ranges (Table 7). Overall, the order by importance of the main prey categories remained consistent at both depths in the summer surveys. An exception to this was that in about half of the summer surveys there was a higher proportion of euphausiids than decapods in the diets of Chinook salmon caught in sets conducted below 30 m, compared with diets of Chinook salmon caught in the surface sets (Table 7). It is possible that this shift was associated with the prey fields available to Chinook salmon in the two depth strata. There was more variability in the order of importance of these categories by depth and less consistency in the trends between depth strata in the fall surveys (Table 8).

5 CONCLUSION

The 18 years of summer and fall diet information show a consistency in the feeding habits of juvenile Chinook salmon in their early ocean residence. The fishes, decapods, amphipods and euphausiids categories consistently represented over 90% of the diets. In addition, Chinook salmon that were not feeding (and had an empty stomach when captured) were represented across all size ranges and, with the exception of some specific years (e.g., 2007), represented a similar proportion of the fish sampled. There is evidence that Chinook salmon that grow faster in the first months in the ocean have higher marine survival (Duffy et al. 2011; Graham et al. 2019). It has been reported that in the Strait of Georgia, coho salmon that grow faster and exceed a growth threshold by a critical period have higher ocean survival (Beamish and Neville 2021). Thus, it is the abundance of these four prey categories and possibly the proportion of Chinook salmon that are not feeding, that most likely relates to improved ocean survival.

Young-of-year Pacific herring were the most important component within the fishes category. The exception was in 2005 and 2007. In both of these years, Schweigert et al. (2009) reported extremely low numbers (< 0.01 kg mean catch) of young-of-year Pacific herring in the annual herring surveys within the Strait of Georgia and there were very few young-of-year Pacific herring caught in the juvenile salmon surveys in these years (Beamish et al. 2012). This low abundance in both the annual herring surveys and the juvenile salmon surveys suggests that this species was not available for the juvenile Chinook salmon as a food source in these years, and was either replaced by other fish species (e.g., juvenile smelt and rockfish in 2005) or by other prey categories (e.g., decapods and "other" categories in 2007). Additionally, in the summer of 2007, there was a large increase in the proportion of empty stomachs (29%) and a reduction in the average volume of food in the stomach. The significantly smaller size of Chinook salmon in the summer of 2007 was possibly a result of these changes (Tables 3, 5) but this has not been directly measured. However, the changes in feeding and in the size of the Chinook salmon were synchronous with the poor growth and survival of many species that resided in the surface waters of the Strait of Georgia in 2007 (Beamish et al. 2012).

There has been an emphasis on producing more Chinook salmon smolts in hatcheries with an expectation that there is "unused" capacity of the Strait of Georgia to produce more sub-adult and adult Chinook salmon. This unused capacity would need to provide an abundance of the prey items commonly found in our diet study. Research that annually monitors the abundance of young-of-the-year Pacific herring in the Strait of Georgia is ongoing, but virtually no research on the factors affecting the abundance of the other major prey groups found in our study is being undertaken. Therefore, if feeding or food availability is related to the success of juvenile Chinook salmon in their early marine residence, there needs to be more research directed at understanding the factors that affect the abundances and the timing of production of the species in the four major diet categories identified in our study.

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Thank you to Carol Cooper of Zotec Services, Nanaimo, for her dedicated contribution to the program. Carol went to sea for extended periods of time over the years and analyzed over 21,000 Chinook salmon stomachs. She also analyzed thousands more stomachs from sets outside the standard track line, e.g., locations surrounding the Strait of Georgia, and for other salmon species (coho, chum, pink and sockeye) collected in these surveys. Her accumulated time at sea exceeded three years and covered all types of weather and sea conditions. Her commitment and dedication to the work and good-natured approach to working in a variety of conditions resulted in a large and unique data set, some of which is presented in this report.

Thank you to Dr. Ruston Sweeting, retired Fisheries and Oceans Canada Biologist, who was Chief Scientist on most of the juvenile salmon surveys prior to 2012. Rusty's interest in Pacific salmon diets, and his efforts to ensure that these surveys were consistently conducted are greatly appreciated.

Thank you to the Captains and crews of CCGS *WE Ricker* and Canadian fishing vessels, the *Frosti, Nordic Pearl*, *Viking Storm* and *Sea Crest*, for their hard work, professionalism and for creating great platforms for us to conduct our surveys over the years. We also thank the dozens of biologists, technicians and volunteers that participated in the surveys over this eighteen-year time period.

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8 TABLES

Table 1. Dates of fishing and number of sets conducted along the standard track line during juvenile Pacific salmon trawl surveys in summer (mid June-mid July) and fall (early September-mid October), 2000-2017.

Summer surveys					Fall surveys				
Survey Code	Vessel	Start Date	End Date	Number of Sets	Survey Code	Vessel	Start Date	End Date	Number of Sets
2000-03	*WE Ricker*	10-Jul-00	20-Jul-00	85	2000-05	*WE Ricker*	14-Sep-00	24-Sep-00	91
2001-03	*WE Ricker*	5-Jul-01	15-Jul-01	91	2001-05	*WE Ricker*	16-Sep-01	26-Sep-01	91
2002-01	*Viking Storm*	2-Jul-02	11-Jul-02	93	2002-02	*WE Ricker*	20-Sep-02	28-Sep-02	78
2003-	no survey				2003-03	*WE Ricker*	9-Sep-03	20-Sep-03	91
2004-02	*WE Ricker*	4-Jul-04	13-Jul-04	105	2004-03	*WE Ricker*	7-Oct-04	18-Oct-04	70
2005-02	F/V *Frosti*	14-Jul-05	21-Jul-05	81	2005-03	F/V *Frosti*	14-Sep-05	21-Sep-05	67
2006-01	*WE Ricker*	9-Jul-06	20-Jul-06	77	2006-02	*WE Ricker*	10-Sep-06	21-Sep-06	75
2007-01	*WE Ricker*	8-Jul-07	15-Jul-07	72	2007-02	*Viking Storm*	17-Sep-07	25-Sep-07	71
2008-02	*WE Ricker*	26-Jun-08	18-Jul-08	99	2008-03	*WE Ricker*	12-Sep-08	24-Sep-08	76
2009-01	*WE Ricker*	26-Jun-09	7-Jul-09	81	2009-02	*WE Ricker*	16-Sep-09	25-Sep-09	84
2010-03	*WE Ricker*	3-Jul-10	15-Jul-10	76	2010-04	*WE Ricker*	15-Sep-10	23-Sep-10	76
2011-03	*WE Ricker*	24-Jun-11	3-Jul-11	79	2011-04	*WE Ricker*	16-Sep-11	23-Sep-11	77
2012-03	*WE Ricker*	22-Jun-12	2-Jul-12	86	2012-04	*WE Ricker*	15-Sep-12	26-Sep-12	82
2013-06	*WE Ricker*	26-Jun-13	6-Jul-13	72	2013-07	*WE Ricker*	18-Sep-13	29-Sep-13	86
2014-10	*WE Ricker*	27-Jun-14	7-Jul-14	79	2014-11	*WE Ricker*	28-Sep-14	7-Oct-14	74
2015-06	*WE Ricker*	24-Jun-15	6-Jul-15	81	2015-14	*WE Ricker*	16-Sep-15	2-Oct-15	85
2016-12	*Nordic Pearl*	5-Jul-16	12-Jul-16	74	2016-16	*Frosti*	17-Oct-16	23-Oct-16	54
2017-04	*Sea Crest*	19-Jun-17	2-Jul-17	73	2017-06	*Sea Crest*	12-Sep-17	23-Sep-17	70

Table 2. List of prey items, by category, found in juvenile Chinook salmon stomachs during summer and fall juvenile Pacific salmon surveys, 2000-2017. The ranking of species or groups within each category and the percent of total volume within each category is provided.

Prey Category	Species or group	Scientific Name	Summer Rank by volume	Summer % of total	Fall Rank by volume	Fall % of total
Fishes	Pacific Herring	*Clupea harengus pallasi*	1	61.3	1	70.7
	Fish remains		2	17.3	2	17.5
	Pacific Sand Lance	*Ammodytes hexapterus*	3	8.7	3	4.6
	Larval fishes		4	4.8	5	1.4
	Rockfishes	Scorpaenidae family	5	2.9	11	0.2
	Smelts	Osmeridae family	6	1.5	4	2.4
	Walleye Pollock	*Theragra chalcogramma*	7	1.4	7	0.8
	Flatfishes	Pleuronectidae family	8	0.7	9	0.3
	Pacific Hake	*Merluccius productus*	9	0.5	6	1.0
	Quillfish	*Ptilichthys goodei*	10	0.5	15	0.0
	Salmon	Salmonidae family	11	0.1	14	0.0
	Poachers	Agonidae family	12	0.1	13	0.1
	Bay Pipefish	*Syngnathus leptorhynchus*	13	0.1	8	0.7
	Cabezon	*Scorpaenichthys marmoratus*	14	0.1	17	0.0
	Lanternfishes	Myctophidae family	15	0.0	10	0.2
	Wolf Eel	*Anarrhichthys ocellatus*	16	0.0	-	
	Sculpins	Cottidae family	17	0.0	16	0.0
	Northern Anchovy	*Engraulis mordax*	-		12	0.1
Decapods	Crab megalops	Cancridae family	1	78.7	1	66.0
	Crab zoea	Cancridae family	2	10.6	4	6.1
	Shrimp	Caridae family	3	8.1	2	14.4
	Calanoid copepod	Calanoida order	4	2.5	3	9.9
	Mysid	Mysidae family	5	0.0	7	0.8
	Barnacles	Cirripedia subclass	6	0.0	5	1.7
	Ostracods	Ostracoda subclass	7	0.0	6	1.0
Amphipods	Hyperiids	Hyperiidea family	1	98.1	1	95.3
	Gammarids	Gammaridae family	2	1.9	2	4.6
Euphausiids		primarily *Euphausia pacfica*	1	100	1	100
Other	Octopus	Enteroctopodidae family	1	58.1	1	23.4
	Insects - flying		2	15.6	5	11.8
	Squids	Ommastrephidae family	3	12.1	4	14.0
	Digested matter		4	6.2	6	8.4
	Arrow worms	Chaetognatha phylum	5	5.5	8	1.5
	Bristle worms	Polychaeta class	6	2.2	7	7.6
	Comb/other jellies	Ctenophora phylum	7	0.1	9	0.3
	Sea slugs and snails	Gastropoda class	-		3	14.4
	Pelagic sea slugs	Pteropoda order	8	0.0	2	18.5
	Tunicate - sea squirt	*Oikopleura* genus	-		10	0.1

Table 3. Diet composition in juvenile Chinook salmon from the summer surveys, 2000-2017. The diet is summarized by major prey categories with both total volume (cc) of each prey category and the proportion (%) of the prey category in the overall diet provided. The number of stomachs examined, percent of stomachs identified as empty and average volume of stomachs with prey identified is provided.

Summer surveys														
Prey category	Fishes		Decapods		Euphausiids		Amphipods		Other		Total Volume (cc)	Percent empty	Ave vol/ stomach (cc)	Number of stomachs examined
Year	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume				
2000	392	57.0	157	22.9	33	4.8	89	13.0	16	2.4	687	13.0	1.16	683
2001	353	59.0	79	13.1	72	12.0	80	13.4	14	2.4	599	12.6	1.00	683
2002	468	70.9	40	6.1	103	15.6	34	5.1	15	2.3	660	14.5	0.96	807
2003	No Survey													
2004	553	77.8	112	15.7	18	2.6	23	3.2	5	0.7	710	13.3	1.02	802
2005	121	47.8	54	21.3	13	5.0	58	23.0	7	2.9	253	12.6	0.73	398
2006	434	73.3	115	19.5	9	1.6	12	2.1	21	3.6	592	12.9	1.13	603
2007	19	9.2	93	45.0	4	1.8	50	24.1	41	20.0	207	28.6	0.42	692
2008	372	83.1	42	9.3	17	3.8	12	2.8	5	1.0	448	20.9	0.87	655
2009	354	70.5	64	12.7	9	1.8	66	13.1	10	2.0	502	15.1	0.95	622
2010	115	38.0	83	27.5	25	8.2	62	20.5	18	5.8	303	18.2	0.60	616
2011	696	88.6	49	6.2	5	0.6	25	3.2	11	1.3	786	14.2	1.37	668
2012	809	84.8	58	6.1	44	4.6	32	3.3	11	1.2	954	12.1	1.66	654
2013	161	50.5	42	13.3	33	10.4	69	21.5	13	4.2	319	11.5	0.73	494
2014	145	46.1	49	15.7	61	19.5	50	16.1	8	2.7	314	17.5	0.68	559
2015	340	79.3	36	8.3	33	7.7	14	3.4	6	1.4	428	26.1	0.82	708
2016	117	53.3	49	22.5	41	18.5	9	3.9	4	1.7	220	26.1	0.64	463
2017	386	68.8	66	11.7	52	9.2	53	9.5	4	0.8	560	24.6	1.24	598
Total	**5,833**		**1,187**		**571**		**739**		**211**		**8,542**			**10,705**
Average		**62.2**		**16.3**		**7.5**		**10.7**		**3.3**		**17.3**	**0.94**	**630**

Table 4. Number of juvenile Chinook salmon with food or with empty stomachs by size range for summer surveys, 2000-2017. Total number of stomachs examined and average fork length ± SD for each year is provided.

Year		Fork length range in summer surveys (mm)																				Total	Average fork length ± SD (mm)
		<70	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	>250		
2000	With food			16	46	32	42	51	60	44	62	59	53	46	28	28	13	7	6	1		594	151 ± 35.7
	Empty		1		6	3	5	6	6	5	11	9	12	9	10	1	4			1		89	
2001	With food		1	6	14	31	40	60	57	57	51	62	96	69	29	14	7	3				597	154 ± 29.8
	Empty				2	2	8	9	4	6	5	9	15	16	7	3						86	
2002	With food			3	12	41	78	91	103	104	80	61	58	38	17	3		1				690	142 ± 24.6
	Empty			2	6	7	10	14	17	19	18	10	5	6	2	1		0				117	
2003		No survey																					
2004	With food	1	8	44	66	60	78	93	66	67	50	39	29	34	30	15	11	1	2		1	695	134 ± 34.1
	Empty			4	14	8	12	21	9	9	9	5	9	3	3		1					107	
2005	With food		1	20	23	28	8	33	55	70	53	26	13	11	4	3						348	138 ± 27.2
	Empty		1	2	2		2	5	9	9	5	5	6	2	1			1				50	
2006	With food		4	49	68	32	14	14	42	74	84	35	20	28	29	20	9	3				525	140 ± 37.4
	Empty		1	10	13	3	3	3	7	4	12	4	8	4	1	2	3					78	
2007	With food	2	13	32	51	120	101	61	47	37	22	5	2	1								494	116 ± 21.0
	Empty		9	9	13	51	36	23	20	16	13	5		2	1							198	
2008	With food	3	10	25	33	62	72	43	43	45	51	56	47	15	12	1						518	132 ± 30.5
	Empty	2	3	5	12	21	16	20	13	12	11	6	9	7								137	
2009	With food		2	4	17	56	63	55	44	66	74	75	41	20	4	5					2	528	140 ± 28.0
	Empty	2	1		6	10	10	10	6	8	17	10	12		2							94	
2010	With food		1	21	33	43	77	54	47	43	58	53	39	17	11	6	1					504	138 ± 30.5
	Empty		1	3	9	7	11	8	5	5	12	17	14	11	7	1		1				112	
2011	With food		1	5	7	15	25	39	71	103	116	85	62	26	11	2	3	1			1	573	150 ± 22.9
	Empty			1	2	5	4	9	8	15	22	13	11	2		1	1					94	
2012	With food	1	1	2	12	29	40	38	63	68	83	76	66	51	24	11	6					571	150 ± 27.7
	Empty		1	2	4	4	8	10	6	15	10	5	7	2	1	1						76	
2013	With food		3	5	19	47	60	64	38	63	36	44	28	17	9	1	1				2	437	136 ± 27.9
	Empty				4	8	8	7	9	6	3	5	4	3								57	
2014	With food		1	5	24	50	62	49	48	52	47	35	37	21	15	8	4		1		1	460	139 ± 29.6
	Empty			3	6	10	8	9	12	19	16	4	7	2	2							98	
2015	With food		3	12	22	23	23	48	70	47	66	50	58	44	32	15	4					517	147 ± 30.7
	Empty		3	8	13	7	5	32	18	21	12	26	25	9	3	2	0	1				185	
2016	With food		4	9	15	31	30	14	19	23	29	44	38	36	22	17	7	2	1		1	342	151 ± 35.6
	Empty		1	2	6	6	12	11	8	7	12	13	18	13	5	6		1				121	
2017	With food	1	5	7	11	23	48	44	68	54	57	57	41	21	9	3	2					451	143 ± 26.8
	Empty			2	2	9	17	17	16	19	22	22	12	2	2	4					1	147	
Total		12	80	318	593	884	1,036	1,065	1,114	1,212	1,229	1,030	902	588	333	174	77	22	10	2	9	10,690	

*In 2011, 2012, 2014 and 2015 some fish length data missing and therefore sample numbers differ from numbers of stomachs examined.

Table 5. Diet composition in juvenile Chinook salmon from the fall surveys, 2000-2017. The diet is summarized by major prey categories with both total volume (cc) of the category and the proportion (%) of the prey category in the overall diet provided. The number of stomachs examined, percent of stomachs identified as empty and average volume of stomachs with prey identified is provided.

Fall surveys														
Prey category	Fishes		Decapods		Euphausiids		Amphipods		Other		Total Volume (cc)	Percent empty	Ave vol/ stomach (cc)	Number of stomachs examined
Year	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume	Volume (cc)	% of total volume				
2000	486	57.1	57	6.7	72	8.5	196	23.2	38	4.5	846	24.1	1.54	**724**
2001	234	46.5	50	10.0	79	15.7	98	19.4	42	8.4	504	24.9	1.40	**481**
2002	510	51.3	51	5.1	189	19.0	198	19.9	47	4.8	995	14.3	1.55	**747**
2003	160	28.3	67	11.8	91	16.0	215	38.1	33	5.8	566	11.3	0.91	**702**
2004	436	51.9	47	5.6	194	23.0	119	14.1	45	5.3	841	17.8	2.09	**490**
2005	74	23.1	38	11.7	60	18.6	130	40.4	20	6.2	322	7.3	0.87	**399**
2006	770	78.0	52	5.3	48	4.9	49	5.0	67	6.8	986	20.9	1.95	**640**
2007	30	6.9	86	19.6	35	8.1	246	56.1	41	9.4	439	5.2	0.72	**667**
2008	121	35.2	19	5.4	50	14.7	126	36.7	28	8.1	343	18.9	0.72	**592**
2009	79	19.3	49	11.9	111	27.2	120	29.6	48	11.9	407	9.0	1.01	**444**
2010	66	13.2	93	18.5	111	22.1	180	35.8	52	10.3	502	10.0	1.01	**550**
2011	282	46.7	72	11.9	48	7.9	177	29.3	25	4.2	603	10.8	0.78	**865**
2012	611	59.1	29	2.8	111	10.8	251	24.3	32	3.0	1,033	11.5	1.45	**803**
2013	149	25.6	11	2.0	233	40.1	174	30.1	13	2.2	580	19.0	1.05	**680**
2014	53	11.7	16	3.4	191	41.7	145	31.8	52	11.4	458	22.3	0.90	**658**
2015	352	51.4	21	3.0	105	15.3	157	22.9	50	7.3	685	26.5	1.17	**800**
2016	86	54.3	3	2.1	13	8.4	53	33.2	3	1.9	159	24.7	0.74	**283**
2017	204	44.4	50	10.9	98	21.2	97	21.0	11	2.4	460	8.1	1.20	**418**
Total	**4,704**		**810**		**1,838**		**2,732**		**648**		**10,729**			**10,943**
Average		**39.1**		**8.2**		**18.0**		**28.4**		**6.3**		**16.0**	**1.17**	**608**

Table 6. Number of juvenile Chinook salmon with food or with empty stomachs by size range for fall surveys, 2000-2017. Total number of stomachs examined and average fork length ± SD for each year is provided.

Year		Fork length range in fall surveys (mm)																				Total	Average fork length ± SD (mm)
		<100	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	190-199	200-209	210-219	220-229	230-239	240-249	250-259	260-269	270-279	>280		
2000	With food		1		10	52	93	75	61	39	19	14	13	22	26	34	37	28	14	9	3	550	187 ± 43.7
	Empty				4	5	15	16	21	13	9	10	10	9	6	14	16	11	9	4	2	174	
2001	With food			1	20	33	39	31	20	13	16	19	28	36	31	19	20	14	13	5	3	361	196 ± 43.9
	Empty					5	7	5	4	4	6	8	8	12	13	10	12	10	14		2	120	
2002	With food	4	35	77	114	106	45	32	14	21	28	34	16	32	31	20	15	7	6	3		640	158 ± 44.5
	Empty	2	5	10	15	20	10			1	5	3	5	4	13	4	4	4		1	1	107	
2003	With food		1	4	34	65	99	104	67	67	34	33	34	25	15	17	17	4	2	1		623	169 ± 33.3
	Empty			1	5	11	13	13	2	6	3	1	3	2	7	5	3	2	2			79	
2004	With food			3	27	44	63	56	27	28	33	27	12	13	18	11	15	8	7	4	7	403	180 ± 42.8
	Empty					7	8	8	5	2	5	4	5	4	12	6	8	7	2		4	87	
2005	With food				1	5	20	52	79	44	36	24	31	36	19	14	7	1	1			370	182 ± 27.1
	Empty						2	5	2	6	3	2		6	1	2						29	
2006	With food	2	19	78	80	60	24	16	10	7	8	13	9	15	18	35	41	30	22	12	7	506	180 ± 57.7
	Empty			7	17	8	4	6	1	2	2	3	5	9	9	16	22	15	5	3		134	
2007	With food		2	12	34	60	109	169	148	60	23	4	4	3	1	3						632	156 ± 18.0
	Empty				3	1	2	9	8	6	1	3	1	1								35	
2008	With food	1	22	89	130	99	46	25	17	9	5	7		3	2	8	3	7	4	2	1	480	139 ± 33.2
	Empty		5	16	29	32	8	1	5	5	1			2	3	2	1	2				112	
2009	With food	1	4	19	28	74	78	32	24	24	29	26	13	15	11	9	6	9	1	1		404	164 ± 38.0
	Empty		1	4	4	5	6	1	1	3	2		2	1	1	1	3		1	4		40	
2010	With food				8	80	135	63	36	18	20	13	16	16	26	19	17	14	8	6		495	171 ± 38.9
	Empty				1	6	13	9	4	3	2	5	1	2	1	4		4				55	
2011	With food	4	36	103	161	127	112	48	31	14	14	21	19	16	22	17	17	8	1	1		772	150 ± 38.8
	Empty		5	7	13	8	11	9	4	1	1	1	4	4	11	4	7	2	1			93	
2012	With food	6	38	74	126	98	55	39	24	27	26	15	19	20	25	27	18	24	26	13	11	711	167 ± 52.6
	Empty			3	6	7	11	4	4	2	4	6	3	6	2	3	10	5	6	3	7	92	
2013	With food				7	34	78	73	27	15	12	27	34	45	53	55	48	20	11	7	4	550	196 ± 42.2
	Empty						9	7	12	8	4	9	6	10	8	17	10	8	13	2	6	129	
2014	With food			4	19	59	87	87	56	26	13	19	15	29	22	24	16	15	11	7	2	511	181 ± 42.0
	Empty			1	0	8	8	11	13	11	8	12	8	13	10	15	8	7	11	2	1	147	
2015	With food				1	13	45	78	80	36	25	31	35	54	50	50	40	25	8	10	8	589	194 ± 38.5
	Empty			1	1	1	26	23	35	20	12	9	17	12	10	16	14	9	5			211	
2016	With food						2	7	28	44	41	21	14	11	1	14	10	8	5	6	1	213	197 ± 31.9
	Empty							2	8	19	10	7	4	2	4	2	4	4	2		2	70	
2017	With food	3	26	44	55	43	31	7	11	10	8	12	16	20	27	25	18	6	12	7	3	384	172 ± 53.8
	Empty			2	4	1	2	1				1	2	3	4	4	2	3	2	2	1	34	
Total		23	200	560	957	1,177	1,316	1,124	889	614	468	444	412	513	513	526	469	321	225	115	76	10,942	

*In 2013 some fish length data missing and therefore sample numbers differ from numbers of stomachs examined.

Table 7. Diet composition in juvenile Chinook salmon caught in waters of 0-29 m (surface waters, head rope depth 0-15 m) and in waters greater than or equal to 30 m (deep waters, head rope depth ≥ 30 m) in the summer surveys, 2000-2017. The diet is summarized by major prey categories and is provided as both volume (cc) of the category and as a percent of total stomach volume. The number of stomachs examined at each depth range is provided.

Year	Summer surveys											
	Head rope depth of 0-15 m						Head rope depth of ≥ 30 m					
	Fishes Vol cc (%)	Decapods Vol cc (%)	Euphausiids Vol cc (%)	Amphipods Vol cc (%)	Other Vol cc (%)	N	Fishes Vol cc (%)	Decapods Vol cc (%)	Euphausiids Vol cc (%)	Amphipods Vol cc (%)	Other Vol cc (%)	N
2000	357 (58.6)	147 (24.2)	16 (2.7)	76 (12.6)	12 (1.9)	**624**	35 (44.4)	10 (12.3)	16 (21.0)	13 (16.5)	5 (5.8)	**59**
2001	274 (57.6)	74 (15.6)	52 (10.8)	66 (13.9)	10 (2.2)	**573**	79 (64.6)	4 (3.6)	20 (16.7)	14 (11.7)	4 (3.4)	**110**
2002	419 (72.6)	32 (5.6)	87 (15.1)	26 (4.4)	13 (2.3)	**691**	49 (58.6)	8 (9.7)	16 (19.3)	8 (10.0)	2 (2.4)	**116**
2003												
2004	535 (78.2)	107 (15.6)	17 (2.6)	22 (3.2)	4 (0.5)	**754**	18 (68.4)	5 (19.6)	<1 (2.7)	1 (5.2)	1 (4.2)	**48**
2005	116 (47.5)	53 (21.4)	12 (4.9)	57 (23.2)	7 (3.0)	**381**	5 (57.0)	1 (16.4)	<1 (10.1)	1 (15.9)	<1 (0.5)	**17**
2006	371 (70.5)	112 (21.3)	9 (1.8)	12 (2.3)	21 (4.0)	**558**	63 (95.4)	3 (4.6)	0 (0.0)	0 (0.0)	0 (0.0)	**45**
2007	16 (9.3)	75 (45.0)	3 (1.9)	41 (24.7)	32 (19.1)	**555**	3 (8.8)	18 (44.8)	<1 (1.5)	8 (21.2)	9 (23.7)	**137**
2008	358 (82.6)	42 (9.6)	17 (3.8)	12 (2.8)	5 (1.1)	**648**	14 (96.6)	0 (0.0)	<1 (3.4)	0 (0.0)	0 (0.0)	**7**
2009	279 (70.7)	57 (14.4)	9 (2.2)	43 (11.0)	7 (1.8)	**496**	76 (69.9)	7 (6.5)	<1 (0.3)	22 (20.5)	3 (2.7)	**126**
2010	72 (37.7)	59 (31.1)	16 (8.5)	32 (16.5)	12 (6.2)	**387**	43 (38.5)	24 (21.3)	8 (7.6)	31 (27.4)	6 (5.3)	**229**
2011	650 (89.0)	43 (5.8)	4 (0.5)	24 (3.3)	10 (1.4)	**604**	45 (83.5)	6 (11.7)	1 (2.4)	1 (1.6)	<1 (0.8)	**64**
2012	717 (85.2)	51 (6.0)	36 (4.3)	27 (3.2)	11 (1.3)	**568**	92 (81.9)	7 (6.3)	8 (7.0)	5 (4.6)	<1 (0.2)	**86**
2013	86 (43.5)	29 (14.9)	21 (10.7)	53 (27.0)	8 (3.9)	**365**	75 (61.9)	13 (10.7)	12 (9.9)	16 (12.8)	6 (4.7)	**129**
2014	112 (55.7)	41 (20.4)	12 (6.0)	30 (15.1)	6 (2.9)	**418**	33(28.9)	8 (7.1)	49 (43.7)	20 (17.9)	3 (2.4)	**141**
2015	278 (77.6)	32 (8.9)	32 (9.0)	11 (3.1)	5 (1.3)	**608**	62 (87.5)	4 (5.3)	<1 (0.9)	3 (4.5)	1 (1.8)	**100**
2016	93 (52.2)	43 (24.3)	33 (18.4)	7 (4.0)	2 (1.0)	**408**	24 (58.2)	6 (14.6)	8 (18.9)	1 (3.6)	2 (4.7)	**55**
2017	316 (67.0)	56 (11.9)	50 (10.6)	47 (9.9)	3 (0.7)	**506**	70 (78.6)	10 (10.9)	2 (1.9)	7 (7.4)	1 (1.2)	**92**
Total	**5,049**	**1,053**	**426**	**587**	**167**	**9,144**	**785**	**134**	**145**	**152**	**43**	**1,561**
Ave %	**62.1**	**17.4**	**6.7**	**10.6**	**3.2**		**63.7**	**12.1**	**9.8**	**10.6**	**3.4**	

Table 8. Diet composition in juvenile Chinook salmon caught in waters of 0-29 m (surface waters, head rope depth 0-15 m) and in waters greater than or equal to 30 m (deep waters, head rope depth ≥ 30 m) in the fall surveys, 2000-2017. The diet is summarized by major prey categories and is provided as both volume (cc) of the category and as a percent of total stomach volume. The number of stomachs examined at each depth range is provided.

	Fall surveys											
	Head rope depth of 0-15 m						Head rope depth of ≥ 30 m					
Year	Fishes Vol cc (%)	Decapods Vol cc (%)	Euphausiids Vol cc (%)	Amphipods Vol cc (%)	Other Vol cc (%)	N	Fishes Vol cc (%)	Decapods Vol cc (%)	Euphausiids Vol cc (%)	Amphipods Vol cc (%)	Other Vol cc (%)	N
2000	437(59.9)	51 (7.0)	57 (7.8)	148 (20.3)	35 (4.9)	**615**	49 (40.0)	6 (4.9)	15 (12.6)	48 (41.1)	3 (2.1)	**109**
2001	165 (47.4)	40 (11.4)	58 (16.6)	50 (14.3)	36 (10.3)	**345**	69 (44.5)	10 (6.7)	21 (13.7)	48 (30.8)	7 (4.3)	**136**
2002	400 (51.7)	41 (5.3)	171 (22.1)	123 (15.9)	38 (4.9)	**582**	110 (49.7)	9 (4.3)	17 (7.9 0	75 (33.8)	10 (4.4)	**165**
2003	101 (24.4)	42 (10.2)	71 (17.0)	173 (41.6)	28 (6.8)	**501**	59 (38.8)	25 (16.4)	20 (13.3)	43 (28.3)	5 (3.1)	**201**
2004	268 (43.4)	46 (7.4)	172 (27.9)	98 (15.9)	34 (5.5)	**384**	168 (75.5)	1 (0.7)	21 (9.5)	21 (9.3)	11 (5.0)	**106**
2005	53 (20.3)	30 (11.3)	55 (21.3)	109 (41.9)	14 (5.3)	**326**	22 (35.0)	8 (13.2)	4 (7.1)	21 (34.4)	6 (10.2)	**73**
2006	655 (80.0)	45 (5.5)	34 (4.2)	43 (5.3)	41 (5.0)	**525**	115 (68.5)	7 (4.2)	14 (8.1)	6 (3.4)	27 (15.9)	**115**
2007	28 (6.9)	80 (19.8)	34 (8.4)	229 (56.7)	33 (8.2)	**609**	3 (7.3)	6 (16.2)	1 (4.1)	17 (49.1)	8 (23.3)	**58**
2008	52 (21.6)	16 (6.8)	48 (19.9)	109 (45.4)	15 (6.2)	**505**	69 (66.5)	2 (2.1)	3 (2.5)	17 (16.4)	13 (12.5)	**87**
2009	48 (18.3)	30 (11.5)	85 (32.4)	74 (28.5)	24 (9.2)	**278**	31 (21.2)	19 (12.7)	26 (17.9)	46 (31.5)	24 (16.7)	**166**
2010	5 (1.6)	62 (18.2)	93 (27.3)	142 (41.5)	39 (11.4)	**424**	61 (38.1)	31 (19.2)	18 (11.1)	38 (23.7)	13 (7.9)	**126**
2011	209 (48.2)	58 (13.4)	34 (7.8)	115 (26.4)	18 (4.2)	**650**	72 (42.8)	13 (8.0)	14 (8.3)	62 (36.6)	7 (4.3)	**215**
2012	372 (59.0)	22 (3.4)	48 (7.7)	167 (26.4)	22 (3.5)	**570**	238 (59.2)	7 (1.7)	63 (15.6)	85 (21.1)	10 (2.4)	**233**
2013	97 (28.4)	8 (2.3)	129 (37.6)	102 (29.9)	6 (1.7)	**399**	52 (21.6)	4 (1.5)	104 (43.7)	72 (30.3)	7 (2.8)	**281**
2014	36 (9.8)	14 (3.7)	160 (43.7)	118 (32.3)	38 (10.5)	**514**	17 (19.1)	2 (2.1)	30 (33.6)	27 (29.8)	14 (15.3)	**144**
2015	240 (52.5)	18 (3.8)	89 (19.4)	100 (21.7)	12 (2.6)	**560**	112 (49.4)	3 (1.3)	16 (7.0)	57 (25.4)	38 (16.9)	**239**
2016	23 (35.2)	3 (4.4)	10 (16.1)	26 (40.4)	3 (4.0)	**168**	63 (67.4)	1 (0.6)	3 (3.2)	27 (28.3)	<1 (0.5)	**115**
2017	142 (39.0)	39 (10.6)	85 (23.5)	89 (24.4)	9 (2.6)	**343**	63 (64.9)	12 (12.0)	12 (12.8)	8 (8.3)	2 (2.0)	**75**
Total	**3,188**	**645**	**1,434**	**2,015**	**589**	**8,298**	**1,372**	**165**	**404**	**717**	**204**	**2,645**
Ave %	**36.0**	**8.7**	**20.0**	**29.4**	**5.9**		**45.0**	**7.1**	**12.9**	**26.8**	**8.3**	

Table 9. Average fork length of Chinook salmon caught in waters 0-29 m (surface waters, head rope depth 0-15 m) and waters greater than or equal to 30 m (deep waters, head rope depth ≥ 30 m) in the summer and fall surveys, 2000-2017. These values include fish with empty stomachs. Years with no significant difference in length between fish caught at the two depth strata are identified by asterisk * ($p > 0.05$).

Year	Summer surveys						Fall surveys					
	Head rope depth of 0-15 m			Head rope depth of ≥ 30 m			Head rope depth of 0-15 m			Head rope depth of ≥ 30 m		
	Average fork length (mm)	± SD	N	Average fork length (mm)	± SD	N	Average fork length (mm)	± SD	N	Average fork length(mm)	± SD	N
2000	149	36.0	624	165	29.4	59	184	45.6	615	200	47.8	109
2001	150	30.1	573	173	19.1	110	195*	45.1	345	198*	40.8	136
2002	141	24.3	691	152	24.3	116	156	43.4	582	164	47.6	165
2003	No survey						167	30.5	501	176	38.9	201
2004	134	34.2	754	149	30.1	48	171	37.1	384	212	44.1	106
2005	137	26.6	381	166	26.2	17	185	27.5	326	172	23.0	73
2006	136	35.3	558	191	19.9	45	179*	57.6	525	182*	58.3	115
2007	111	18.9	555	133	19.3	137	155	17.5	609	161	22.0	58
2008	132	30.3	648	171	11.7	7	136	28.5	505	156	50.2	87
2009	138	27.5	496	151	27.5	126	157	35.0	278	175	40.1	166
2010	133	31.1	387	148	26.9	229	160	30.7	424	208	40.7	126
2011[a]	149*	23.4	603	152*	17.0	64	145	35.7	650	165	43.5	215
2012[a]	150*	27.0	568	146*	32.3	79	155	45.7	570	194	58.0	233
2013[a]	135	29.0	365	139	24.5	129	178	39.9	398	221	31.2	281
2014[a]	134	29.0	417	155	26.0	141	170	35.7	514	222	36.7	144
2015[a]	144	30.6	602	170	19.8	100	189	35.4	560	207	41.9	240
2016	149	35.4	408	167	33.5	55	193	27.7	168	202	36.7	115
2017	143*	27	506	144*	23.2	92	163	52.4	343	215	37.1	75
Total			**9,136**			**1,554**			**8,297**			**2,645**
Average	**139**			**153**			**169**			**192**		

[a] In some years, some fish length data was missing and therefore sample numbers differ from numbers of lengths available

9 FIGURES

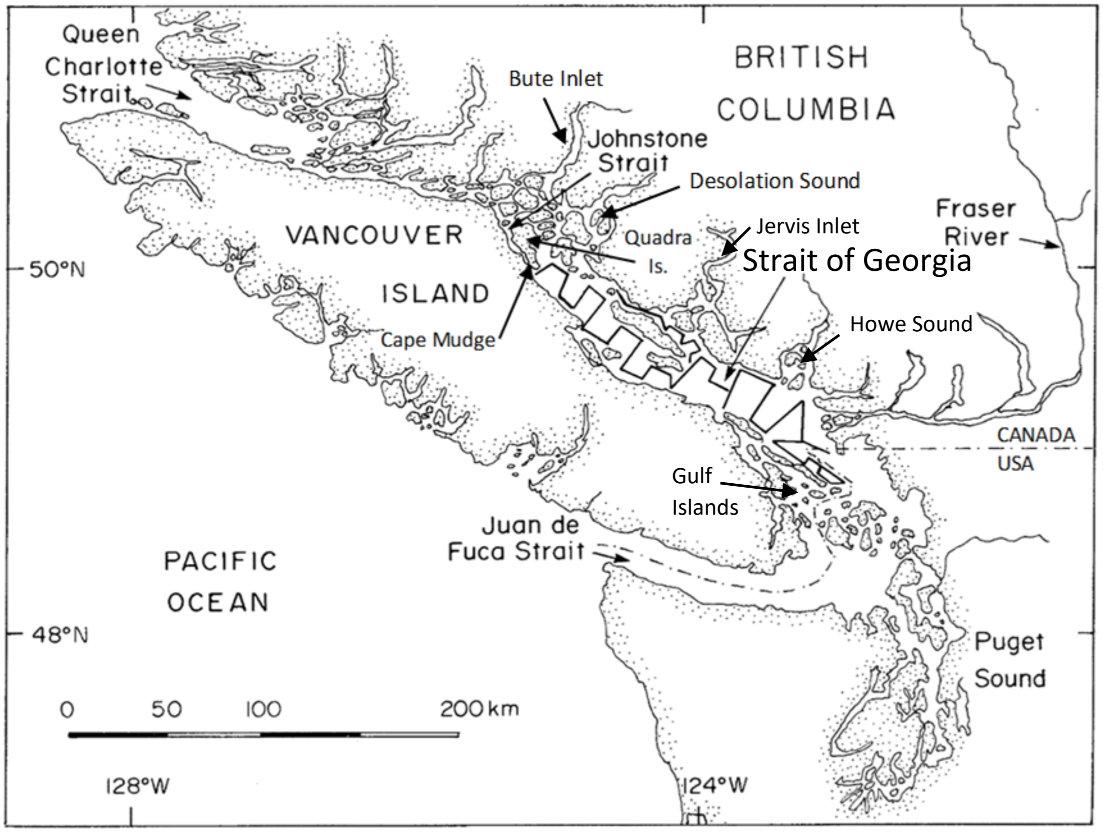

Figure 1. The study area in the Strait of Georgia, an inland sea located between Vancouver Island and the mainland of British Columbia, Canada. Samples presented in this report were collected along the standard track line. This is identified by the black solid line extending through the Strait of Georgia from Cape Mudge in the northwest to the Canada / U.S. border in the south.

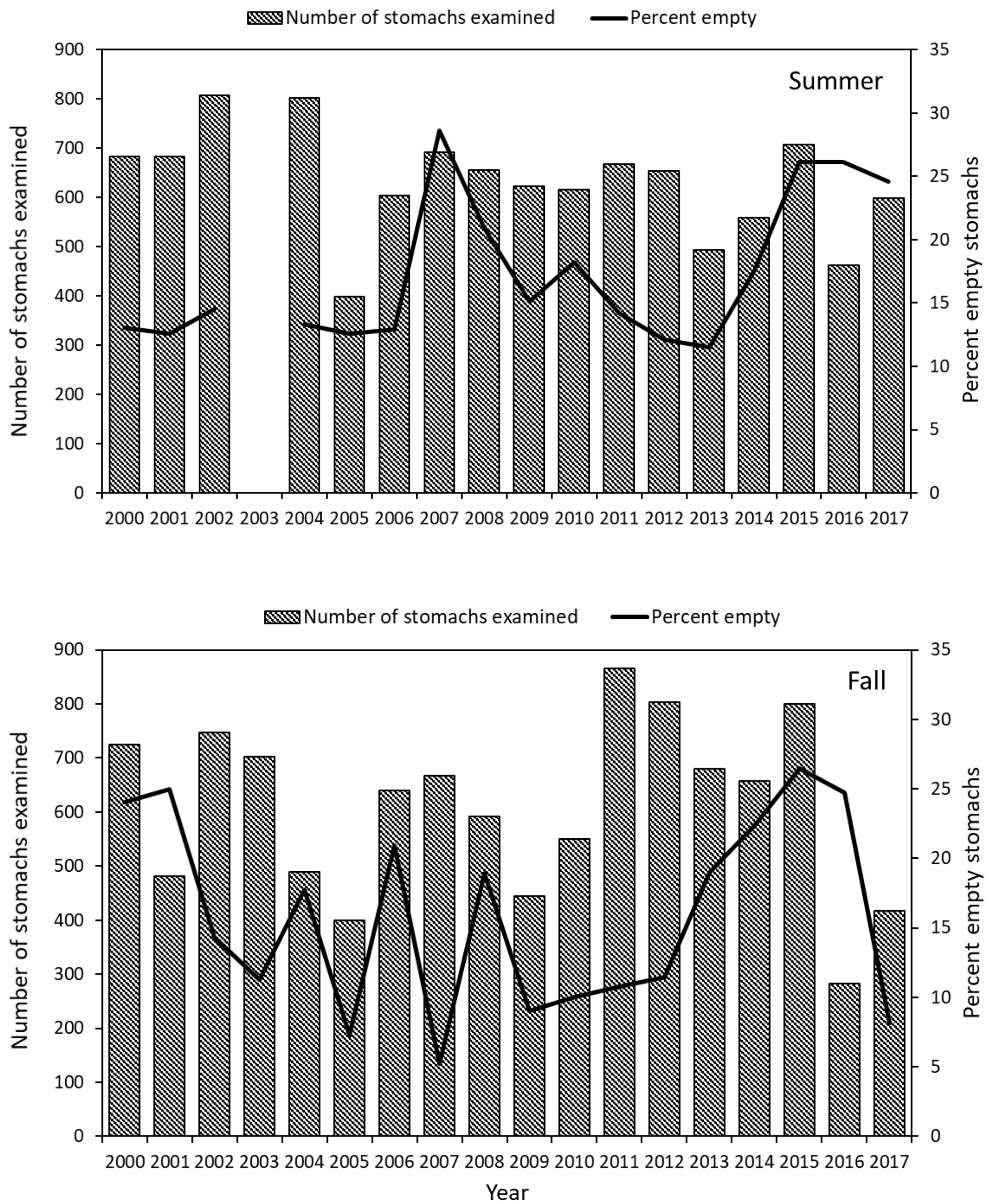

Figure 2. Number of stomachs examined and percentage of empty stomachs of juvenile Chinook salmon captured in the summer (upper panel) and fall (lower panel) surveys , 2000-2017.

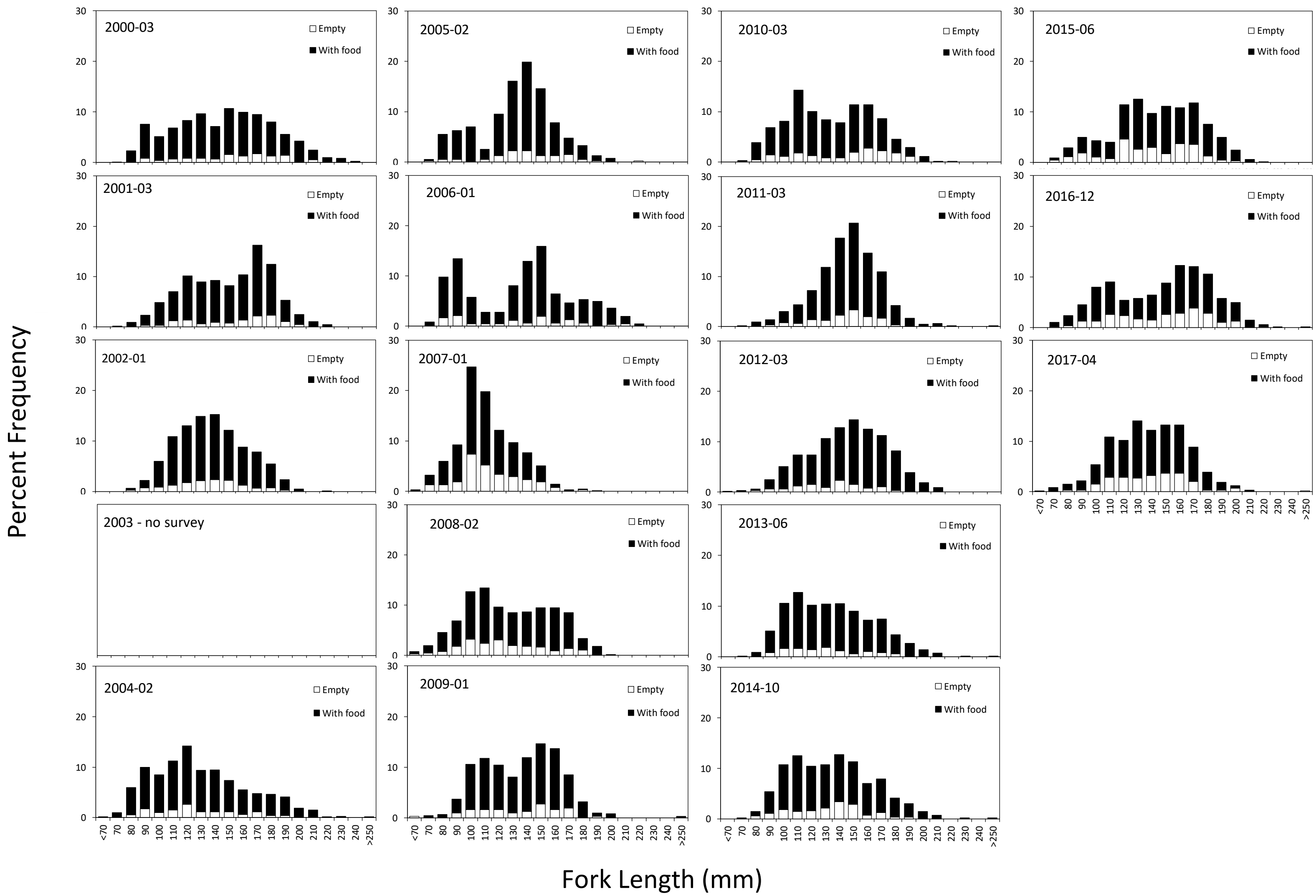

Figure 3. Length frequency distribution (percent frequency) of juvenile Chinook salmon in the summer surveys, 2000-2017. The white bars represent number of fish with empty stomachs and black bars represent number of fish with food identified within the stomach.

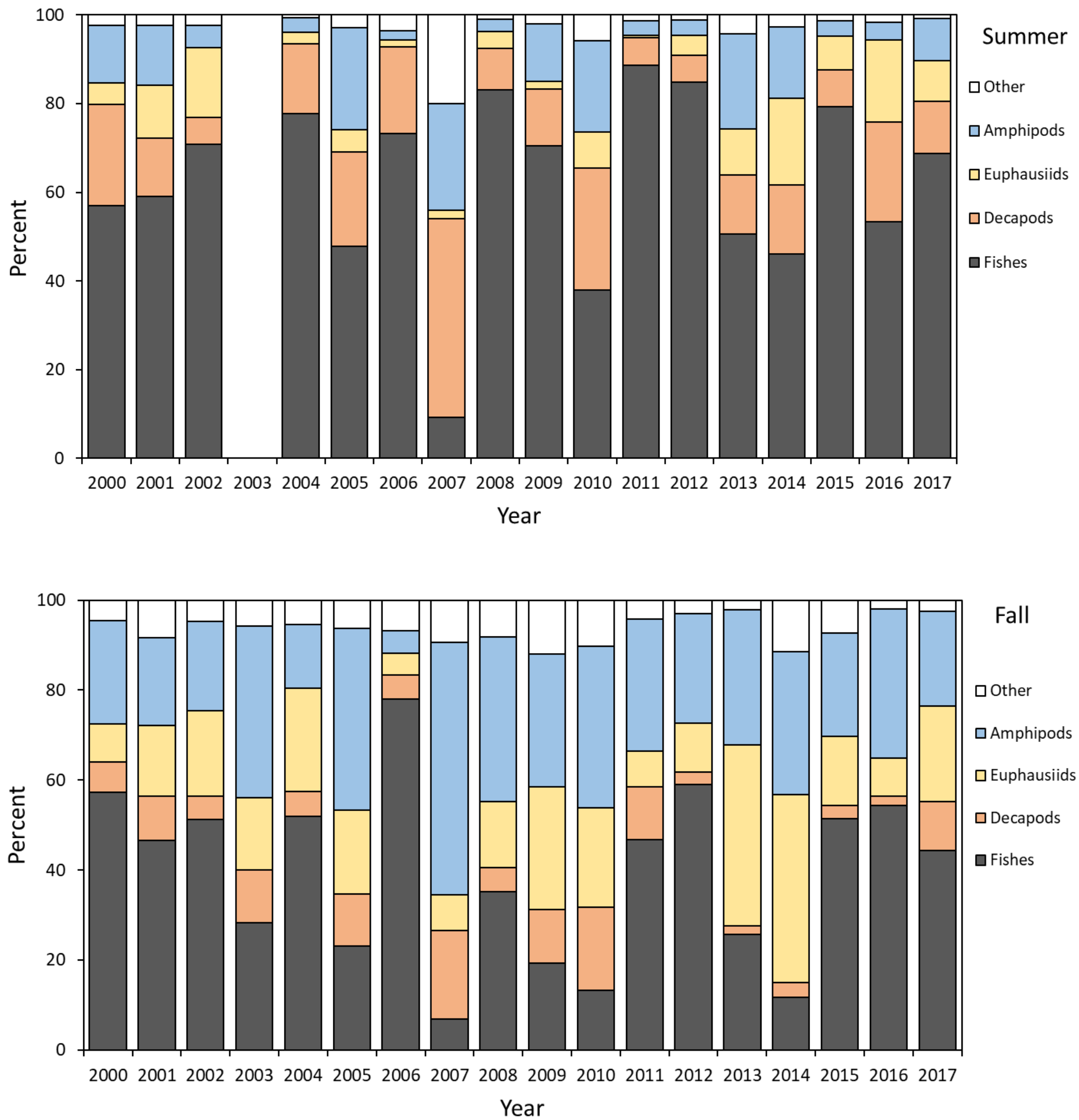

Figure 4. Average diet composition (percent of total volume) in juvenile Chinook salmon stomachs examined from the summer (upper panel) and fall (lower panel) surveys, 2000-2017.

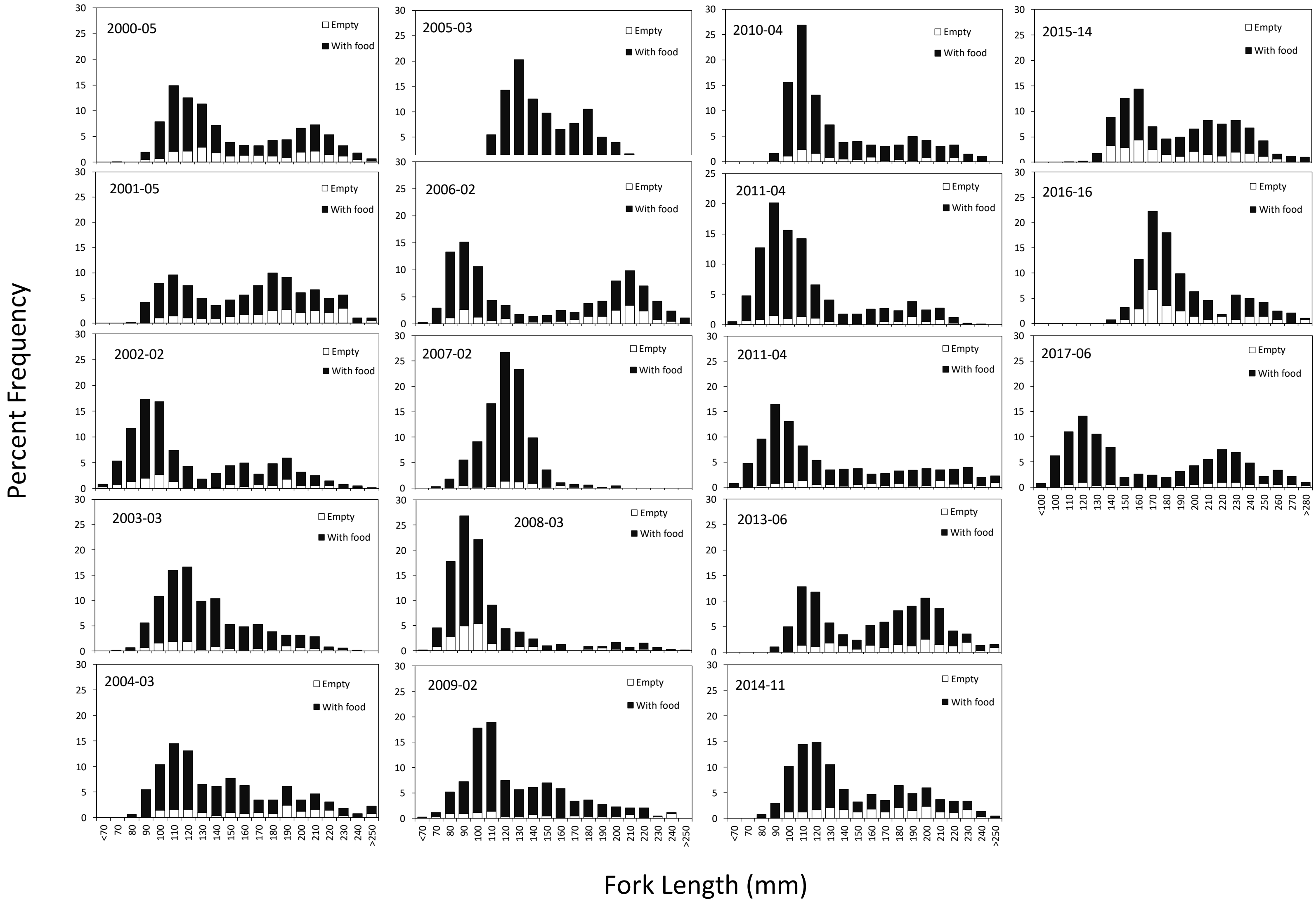

Figure 5. Length frequency distribution (percent frequency) of juvenile Chinook salmon in the fall surveys, 2000-2017. The white bars represent number of fish with empty stomachs and black bars represent number of fish with food identified within the stomach.