Fishing Vessel Safety Longitudinal Analysis:

1989-2001

By

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Introduction

Research to date has shown that work-related accidents are a major source of disability and death for fish harvesters. The general objectives of the Fishing Vessel Safety Longitudinal Analysis (FVSLA) component of SafeCatch are to develop a new, longitudinal, linked database linking claims data from the Newfoundland and Labrador Workplace Health Safety and Compensation Commission (NL WHSCC) with Department of Fisheries and Oceans (DFO) inter-departmental datasets for catch and effort and Search and Rescue (SAR) SISAR data in order to better identify trends in occupational injuries, fatalities and SAR incidents among fish harvesters from 1989 to 2001 and to explore some of the factors responsible for these trends. The period between 1989 and 2001 was characterized by substantial change in the industry that included restructuring of the fleet, changes in the volume and location of fishing activity, changes in targeted species, and in fisheries management initiatives. This period was also associated with the introduction of a professionalization program for fish harvesters that included requirements for safety training. Starting in the mid-1990s, for vessels less than 65 feet, fish harvester injuries and fatalities increased, as did Search and Rescue (SAR) incidents (Pelot 2000; Wiseman and Burge 2000) but without effective attribution or significant correlation to any known factors.

Linked datasets can potentially deepen our understanding of fishing occupational health and safety issues. Pelot (2000) linked SAR incidents data with Fisheries and Oceans inter-departmental datasets for catch and effort, but the latter datasets from Fisheries and Oceans were not linked with the database on injury claims at the NL WHSCC. The primary research tool for FVSLA is a new, linked database that has been designed, negotiated and established for the purposes of this research.

To date, it has taken approximately two years to design, obtain permissions, and to develop this new research tool and another 18 months to clean and link the datasets. During the design phase, the FVSLA research team consulted with representatives from the DFO Statistics and Licensing Offices; NL WHSCC; fish harvester organizations; and third-party research groups and individuals. After consultation, it was agreed that the most appropriate available data structure for the FVSLA would be a cross-institutional, anonymous data linkage at the level of individual injury or fatality created by a neutral third party (the Newfoundland and Labrador Centre for Health Information) and anonymized prior to release to the research team. This kind of linked data structure would permit the development of analyses and analytical models that could substantially extend findings available from separate manipulation of these datasets.

The principal sources of information for the FVSLA are a set of electronic and paper databases administered by various partners in the Fishing Vessel Safety project. The databases currently involved in this study include:

- The NL WHSCC Claims Database for the Newfoundland and Labrador Fishing Industry which combines the Administrative Claims Database and Employers Database from 1989 to 2001 inclusive;
- The SAR SIRSAR Database for resources tasked to fishing vessels in Newfoundland and Labrador waters from 1994 to 2001 inclusive; and,

- DFO Catch and Effort Database which combines the Trip Logs and Purchase Slip Databases for fishing vessels sailing from Newfoundland and Labrador from 1989 to 2001 inclusive.

Other databases, such as weather data from Environment Canada for the area and period under study and data from the DFO licensing database could be added in the future.

Development of a data linkage process acceptable to all parties and to university ethics committees required an extensive consultation process. The result of this consultation process was the NL WHSCC Data Sharing Agreement 2004. This agreement sets out the terms and conditions between NL WHSCC and SafetyNet, the Newfoundland and Labrador Centre for Health Information (NLCHI), Memorial University of Newfoundland (MUN) and Dalhousie University for data sharing within the research project including privacy protection. The Interdisciplinary Committee on Ethics in Human Research at Memorial University and the Health Sciences Human Research Ethics Board at Dalhousie University gave ethical approval for this project.

Several ethical considerations emerged during the consultations and were addressed in the Data Sharing Agreement and in our applications to ethics committees. To protect individual privacy and to maintain anonymity and confidentiality throughout the process, the NLCHI[1] played the role of trusted third party. In this role, staff at the NLCHI received the original databases from the suppliers containing the limited personal identification information necessary to carry out the linkage. These staff formatted the datasets into Microsoft Access, carried out some preliminary data cleaning, devised a method for linking the databases through the introduction of new variables, prepared the datasets for linkage, and then removed or encrypted any personal data or unique identifiers so that confidentiality and anonymity were assured while still maintaining the integrity of the database. The three databases in their anonymized form were encrypted and then transferred to Dalhousie University's Office of Research. When the Dalhousie University's Office of Research received evidence of ethics clearance and once the teams' research office had been set up in compliance with the Data Sharing Agreement, the Office of Research released the data to the data steward, Dr. Marian Binkley, in January 2005. The encrypted files were then decoded and transferred to SPSS format (the statistical package used for data analysis) for further cleaning, recoding and analysis.

Throughout the analysis and preparation of the data we are attempting to assure the highest level of confidentiality. To prevent the possibility of residual identification of an individual, any reported results with less than five claims are masked and indicated by the symbol "<5". Throughout this report, the privacy of employers has been protected in a

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1 "Established by the Newfoundland and Labrador provincial government in 1996, the NLCHI is the only organization in the province that has the resources, mandate and authority to act as a Trusted Third Party. It is a non-profit, partially publicly funded centre that is responsible for designing and implementing the provincial Health Information Network. For further information on the NLCHI, please consult their website at http://www.nlchi.nf.ca/.

similar manner. In order to avoid identifying the employers, pertinent information was encrypted or removed by all three agencies prior to the transfer of data, and reported results with less than five employers were also indicated by the symbol “<5”.

Preparing the Databases for Linkage

Linking databases creates interesting challenges. One of these challenges is that each database uses a different unit of analysis. The unit of analysis for the NL WHSCC database is the claim. An incident generates one or more claims depending on the number of individuals involved. Moreover, one individual may, through the course of the study, be involved in more than one incident, and thus may be associated with more than one claim. The unit of analysis for the SAR database is “resource tasked”. This means that a new line of information is generated whenever the Coast Guard uses a resource. But an individual incident may only require one resource, or it may require five or six and it may or may not result in claims to NL WHSCC. In the case of the DFO database, the unit of analysis is the trip or voyage. Each time the vessel leaves port on a fishing trip it generates a line of information whether they actually fish or not. Thus an incident on a fishing trip may result in one or more individuals submitting claims to NL WHSCC (or no one submitting claims), and/or in SAR tasking one or more resources. One of this project’s aims is to create a database that reflects this interaction.

Another interesting challenge was that the NLCHI staff who prepared the databases for linkage had never actually linked or used the linked database for analysis. However, their work was crucial to the development and conduct of an ethical procedure for sharing information across agencies in a form that protects anonymity and confidentiality, and to the creation of the database. Subsequent analysis depends on their expertise in its preparation. Thus it is important to understand how they went about this process. The DFO catch and effort database formed the core database for the linkage. The data linkage for the FVSLA consisted of matching SAR SISAR incidents (which may have contained more than one record), or NL WHSCC claims, to individual fishing trips that were recorded in the DFO Catch and Effort database (which also may have contained more than one record per fishing trip).

NLCHI staff created the following fields and then used them to link the DFO database with the SAR and NL WHSCC databases: CFV (Fishing Vessel Number, Side Number, Vessel Code) which identifies the fishing vessel with a registration number; FV NAME (Fishing Vessel Name, Vessel Description) a secondary identifier for fishing vessels which may be useful for linkages with the SAR and NL WHSCC data where CFV are missing; FIN (Fisher Identification Number) which identifies a holder of a fishing license with a unique identifier; and FH NAME (Fisher Name, Fish Harvester Name) which identifies a holder of a fishing license by name. NLCHI staff also created a new field in the Catch and Effort database, LOG TRIP, which represented one unique fishing trip and was defined as all of the Catch and Effort records associated to a unique fishing vessel within the time that the vessel left its homeport and the time that the vessel returned to its port of landing.

In order for NLCHI staff to link a SAR SISAR incident or NL WHSCC claim to a fishing trip, the following criteria had to be met:

1) A match on the fishing vessel identifiers in both databases (DFO Catch and Effort and the SAR SISAR or NL WHSCC claims databases), determined by the CFV and/or FV NAME, or;
2) A match on the fish harvester identifier in both databases (DFO Catch and Effort and the SAR SISAR or NL WHSCC claims databases), determined by the FIN number, and;
3) The SAR SISAR incident or NL WHSCC claim had to occur within the time of a fishing trip, the range for which was determined by the date sailed (the date that the fishing vessel left its homeport) and the date landed (the date that the fishing vessel returned to land and sold its catch). Then the NLCHI staff created the LOG TRIP variable for both the SAR SISAR and the NL WHSCC claims databases.

Where the above criteria were satisfied, the data for the LOG TRIP field in the SAR SISAR and NL WHSCC databases were matched to the LOG TRIP data in the DFO Catch and Effort database. Therefore, the SAR SISAR and NL WHSCC claims databases each have a field that will link, where the criteria were met, the incidents or claims to an individual fishing trip.

Using SPSS, the NLCHI staff created a working standard index that combined fishing vessel identifiers (i.e., name, CFV#, side number, and license number) from the licensing database with raw data in the ZIF files. The index was used to fill in missing information in the DFO data, and to fill in missing information or to correct inaccurate information in the SAR and NL WHSCC databases. The NLCHI team also used this index to fill in missing data on vessel descriptors, namely tonnage, length and brake horsepower[2]. NLCHI generated a similar index to the vessel identifier index for fish harvesters based on the FIN (i.e., fisher identification number) and other fish harvester descriptor variables. They used this index to fill in missing data and then encrypted it to assist with the linkage between the DFO ZIF database and the NL WHSCC claims database. The NLCHI team found the programming for this index problematic and requested assistance from a DFO statistician, as well as a NLCHI database manager on site.

In order to link individual incidents in the SAR SISAR database to fishing activity, as represented by records in the DFO Catch and Effort database, the NLCHI team required the following types of information:
1) Temporal information related to the date of the incident. There are several temporal fields in the SAR SISAR database, relating to various aspects of the search and rescue operation, including date and time of alert, length of rescue operation and reaction time. The main field used for linkage was INCIDENT OCCURRED (UTC). This field recorded the estimated date and time of the incident, where time was recorded in Universal Time Code (UTC), also known as Zulu Time or Greenwich Mean Time.
2) Vessel identifier fields. As with the temporal fields, there are several fields that serve to identify the vessels involved in the SAR incident. The fields of interest were those shared by the DFO Catch and Effort database, in particular the CFV (certified fishing

[2] The Licensing database also includes other descriptors, including breath and hull type, but since these variables are not included in the ZIF file, they cannot be included in the final linked database because of the Data Sharing Agreement.

vessel) number and the FISHING VESSEL NAME. There are additional fields in the database, including CALL SIGN, LICENSE NUMBER, and LLOYD'S NUMBER.

NLCHI staff developed a measure of linkage integrity to distinguish the quality of the linkages since there were records in the NL WHSCC and SAR database, which did not have unique identifiers that could be used in a confirmed one-to-one linkage. The working scale has three levels:
1) Level 1: A record specific one-to-one linkage, based on matching at least one unique identifier, date and at least one other variable, e.g. region.
2) Level 2: A record specific one-to-one linkage, based on matching two non-unique identifier variables, one each for vessel and fish harvester, date, region, and at least one other variable, e.g. buyer.
3) Level 3: A record specific one-to-one linkage, based on matching one unique identifier variable, date, region, and at least two other variables.

Once the NLCHI staff had prepared the databases for linkage, they removed or encrypted all the identifying information from the database before releasing the datasets to the data steward. Thus no new linkages can be made based on the data available.

Linking the Dataset
Once all the databases had been cleaned and prepared for linkage, we developed, using SPSS, a "subfile" structure for each individual database that maintained the integrity of the original dataset yet allowed the merger of linked files for all or some variables in those files. Thus each database had two subfiles – "linked" and "unlinked" files. This structure allowed us to compare linked and unlinked files within a given database as well as to examine the connection between databases. Because the SAR database only recorded cases from 1994 onwards, each of the other databases had their files also divided into two subfiles – "before 1994" and "1994 and after." This allowed us to link files for the whole time period when we were examining connections between the NL WHSCC and DFO databases, but limit the number of cases involved when examining connections among all three databases, or the SAR database with variables either in the SAR or DFO databases. In the case of the SAR database a subfile based on the "status" variable separated out the "legitimate" fishing vessel files from other cases (e.g., pleasure boats). Efficiency was also improved by limiting the number of variables (e.g., through SPSS "keep" command) in each database for particular runs.

Development of the FVSLA Linked Database

Once the individual databases arrived at Dalhousie University they had to be cleaned and modified before they could be linked and used for analysis. Much of the data arrived in string format, or in the form of non-numerical variables. String variables were converted to numerical format that significantly increased the possibilities for statistical analysis.

Dates had been entered into the databases using different formats and in some cases different formats were used in the same databases. It is imperative that the format for dates be consistent and that the format be readable by SPSS, accordingly we have chosen the format "yyyy-mm-dd." Variables denoting the date of some events in the format "dd-mmm-yyyy" were recoded to create three new variables expressing the year, month, and day – as stand-alone data - of the same event. From these three new variables we reconstructed a new variable in "yyyy-mm-dd" sequence. For some DFO variables, such as *date landed* and *date caught*, the process was more complex because they were formatted "yyyy-mmm-dd" with the month indicated with three letters. Again we created three new variables expressing the year, month, and day – as stand-alone data of the same event. We then converted the month variable from alphabetic to numeric and reconstructed a new variable in the preferred format.

The NL WHSCC database, which comprised 5260 viable cases, is the core database of the analysis to date carried out through the FVSLA. Data fields include demographic parameters, occupational code, nature of injury, source of injury, type of accident, part of body injured, compensation granted and time lost, and employer's characteristics. In order to maintain confidentiality -- for both claimant and employer -- we recoded a number of variables. The stochastic variation in the numbers of births per year meant we had to use cohort analysis -- five-year, ten-year, and twenty-year cohorts -- to maintain confidentiality. We also recoded the region variable into larger units.

Our main concern about data quality in the NL WHSCC database relates to changes to the coding system for variables over the study period. The NL WHSCC claims database contains four fields that describe the occupational injury or fatality. In 1997, there was a major shift in the coding protocol: some older codes were removed and some newer ones were introduced. A related issue arose from the high degree of specificity of some of the codes that give detail to individual cases but make aggregation and generalisation of results difficult. We addressed these problems by following the re-categorisation process outlined in Navarro and colleagues (2004) for similar NL WHSCC data on forestry workers:

> The objectives of the re-categorization are to group the codes into categories that are meaningful and may be reasonably expected to apply evenly over the study period. The coding standard for occupational injury and fatality claims is developed by the Canadian Standards Association and is referred to as CSA Z795. The Association of Worker Compensation Boards of Canada assists in updating the coding system on a yearly basis and promotes its usage in Canada.
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> The coding system is hierarchical, with a small number of upper level categories that are differentiated by three sub-levels. This taxonomy works the same way as that used in biology. The system allows, to a limited degree, for more detailed, lower-level codes to be grouped together without reviewing the occupational injury or fatality report. Also, the higher levels have remained largely unchanged during the study period.

The re-categorization process grouped individual fourth sub-level codes into a higher level code grouping. The initial step was to re-code all of the original codes to the first/highest level. These categories were then sub-divided on an ad hoc basis with the objective of obtaining approximately 10 codes that had a high degree of descriptive validity. The process of defining categories relied on feedback from the entire research team (Clothier & Laflamme 1985) (c.f., Navarro, Neis, MacDonald, and Lawson, 2004).The re-coding of the four variables – “Nature of Injury”, “Source of Injury”, “Type of Accident” and “Part of Body” -- followed the format described in this earlier study.

For the NL WHSCC database, sectors of the fishing industry derived from the Newfoundland Industry Codes, where “0310 Fishing (per $100 of fish purchased)” indicated the “Offshore Fishery,” “0311 Salt Water Fishing Industry” indicate the “Inshore Fishery,” and “8171 Factory Freezer Trawler” indicate the “Factory Freezer Trawler Fishery.” Occupational classification within the fishery was recoded. All cases were placed into one of three sectors: fishing, service including support and shore crew, and processing. The fishing sector was also recoded into inshore, offshore and trawler (factory freezer trawler) sectors. The latter were broken down by categories of officers, crew, and engineers. In 51 cases NL WHSCC miscoded marine engineers as “engineers and architects.” Sub-groups based on the claimant’s occupational classification were employed where applicable. In order to preserve confidentiality, when numbers of claimants of specific occupational groups were less than five claimants they were either collapsed into another related category or the results were indicated by the symbol “<5”.

The DFO Catch and Effort Database describes fishing activity from 1989 to 2001 (inclusive) and links two individual databases. The “catch” database describes the landings made by fish harvesters and collected by dockside monitors. The dockside-monitoring program now applies to all fisheries; however, since the government phased the program in during the 1990’s, coverage was not uniform for all fisheries over the study period. The “effort” database describes fishing activity at the level of individual fishing vessels and is derived from information in captain’s logs. All vessels that are 35 feet or longer in length must maintain log books as do some special fisheries for which DFO wants data on effort. For the vessels under 35 feet in length, effort is estimated from catch information. The database comprised 3,799,106 cases based on individual fishing trips. Data fields include homeport, NAFO areas and divisions, gear, port of landing and species (caught, sought and landed), buyer, as well as variables describing the fishing effort, including days at sea, days on ground, days fished, hours fished, date caught, latitude and longitude.

The Catch and Effort Database underwent a major revision in 1997. DFO had been reviewing the data from the earlier years in an effort to increase the data quality. Starting with the 1998 fishing season, the database was maintained using Oracle (relational database) software and new data fields were added, which greatly increase the data quality. The Catch and Effort Database, made available to the project in Zonal Interchange File (ZIF) format, presents the data in a flat file format or as one big table. Since the original databases were programmed as relational databases with multiple tables nested in a hierarchical structure, the ZIF format had a relatively high degree of redundancy built into it.

The catch and effort data have four levels which model fishing activity during the fishing trip: Log Trip, Log Day, Log Set and Log Catch. An individual fishing trip consists of a fishing vessel leaving its homeport, going to sea, trying to catch fish and if successful, actually catching fish, and finally returning to the port of landing where a dockside monitor records the catch. The Log Catch is a captain’s logbook entry for a catch, and is the most basic level of catch and effort data. The next level up is the Log Set level.

Depending on the type of fishing taking place, a fishing vessel may have one or more catches for each set. For example, a trawler might have an individual Log Set that lasts half of the working day, during which time the vessel may haul in its nets several times (each time being one Log Catch). The next level, the Log Day, describes a working day at sea for the fishing vessel. When fishing there may be one or more Log Sets for any given Log Day, but the fishing vessel may be at sea for days when it is not fishing at all, for example if the fishing grounds take several days to reach. The highest level, the Log Trip, incorporates all activity from the time a fishing vessel leaves its homeport to the time it brings in its catch at a port of landing.

Since the ZIF file is a flat file, each row represents one Log Catch entry. In some cases, the entry is a dummy entry since no Log Catch information is actually recorded. The same may be true for the Log Set and Log Day levels. However, where complete data have been collected and entered into the database, each row represents one Log Catch datum. This means that Log Set, Log Day and Log Trip data are repeated within each subsequent level, as illustrated below:

Log Trip	Log Day	Log Set	Log Catch
A	Monday	1	15 kg
A	Monday	1	2 kg
A	Monday	2	0 kg
A	Monday	2	14 kg
A	Tuesday	1	6 kg
A	Tuesday	1	8 kg
A	Friday	1	2 kg
A	Friday	2	17 kg
A	Friday	2	18 kg
A	Friday	3	10 kg

In this example, the above table represents one Log Trip for a vessel. The thick black lines delineate the Log Day and the double lines delineate the Log Set. The example highlights how the data are structured in the ZIF format. Within the Catch and Effort Database, several fields may be used to differentiate individual Log Sets, Log Days and Log Trips.

For some variables in the DFO database, both variable names and value labels had to be added. We relied on the publications DFO Value Codes and Pelot, R., M.Buckrell, H.J. Zhu, C. Hilliard (2000) as well as personal contacts with DFO staff, and Ron Pelot and his research assistants to help us sort out the correct labels for the variables.

The SAR database comprises of 10,498 records of resources tasked representing 2571 incidents encompassing the years 1994-2001. Each record represented a tasked resource associated with a specific incident, thus one or more records may represent an individual incident. Records belonging to the same incident have been grouped and given the same incident number in a separate field. Only records related to fishing vessel incidents were to be included in the dataset: records without enough information to determine that the incident was related to a fishing vessel from Newfoundland and Labrador were excluded as were incidents related only to pleasure boats or international vessels. A new variable, STATUS, was created to label the records as eligible or not for linkage. Only records deemed eligible were further cleaned and prepared for the data linkage by NLCHI staff.

For most variables in the SAR database both variable names and value labels had to be added. We relied on the Canadian Coast Guard, Search and Rescue SAR V.8.0 User Guide, SAR Value Codes and Pelot, R., M.Buckrell, H.J. Zhu, C. Hilliard (2000) Maritime Activity and Risk Investigation Network, Newfoundland Incidents: Data Cleaning Process as well as personal contacts with SAR staff and Ron Pelot and his research assistants to help us sort out the correct labels for the variables.

Findings to Date

The FVSLA linked database will provide many opportunities for analysis over the next several years. Our group started by examining WHSCC data for trends over time in the incidence of reported accidents and fatalities, the nature of accident, the body part injured, severity of injures, and seasonality. To date, we have completed a descriptive summary of the NL WHSCC data for trends over time in incidence of reported accidents and fatalities, nature of accident, body part injured, source of injury, severity of injury, and time lost.

Some of our preliminary findings are:
After 1992 the number of NL WHSCC claims declined dramatically, reached its low point in 1995, and gradually increased before starting to level off in 2000 and 2001 (See Figure 1.) The early decline in the number of claims is probably partly due to the decline in the workforce wrought by the imposition of the Groundfish Moratoria in 1992/3 and to related reductions in hours of exposure for individual harvesters during the early years of the moratoria. But over the same period the make-up of the fishing fleet changed dramatically as well and was reflected in a change in the proportions of claims from the various sectors, notably the decline in the offshore fishery, and the relative and absolute growth in the inshore. About 3436 or sixty-five percent of the 5260 claims reported to WHSCC over the study period occurred in the inshore fishery, 1660 or 32 percent in the offshore fishery, and 164 or 3 percent on factory freezer trawlers. It is apparent from this distribution that the increase in the number of claims from 1995 to 2001 came predominantly from the inshore fishing sector (see Figure 2).

With respect to age of the overwhelmingly male claimants, at the time of filing a claim, the mean and the median birth years were 1955, and the mode was 1953 with the range of birth years from 1922 to 1996 (See Figure 3.) The age distribution for all claimants approximates a normal distribution; however, inshore claimants were younger. We do not know if the age distribution of claimants is representative of the total population of fishers.

In terms of occupation within the fishery, about 97 percent of all claims were made by fishers, 2 percent were by processing workers including those on factory freezer trawlers, and 1 percent came from employees servicing the industry.

Of the 5260 claims, 49 claims were report only, 1676 claimants received medical aid only, 3159 claimants received compensation for lost time, and 76 claims represented fatalities. The average number of "lost time in weeks" for claimants was 21.9 weeks; the average "lost time in dollars" was $8,106.68; and the average "Medical aid" payment was $2,942.62. However, the high standard deviations for these variables indicate that there is a great deal of variability in the claim amounts for "lost time,"(ranged from an hour to 288.7 weeks), "lost time dollars" (ranged from $13.49 to $98,212.6) and "medical aid" (ranged from $9.40- $96,631).

Tables 1 through 4 summarize all the claims during the study period in terms of Nature of Injury, Source of Injury, Type of Accident, and Part of Body respectively for all claimants and by fishery sector. These tables provide basic descriptions of the accidents involved in the claims and an indication of the most common characteristics of the accidents for fishers. Tables 5 through 8 describe the cross-tabulations for Nature of Injury, Source of Injury, Type of Accident, and Part of Body by year for all fishers. These tables provide a temporal map for the accident descriptors during the thirteen-year study period.

Accidents and resulting injuries can be assigned into three general groupings: contact with equipment, slips and falls, and overexertion. Accidents involving contact with equipment result in injuries, including deep to surface wounds, bruises, and traumatic injuries to bones, nerves and spinal column, to the upper and lower extremities, head and neck. Slips and falls on hard surfaces result in traumatic injuries to joints, muscles and other soft tissues, primarily of the back and lower limbs, while falling overboard can result in drowning. Over time, transportation accidents have increased while slips and falls on vessels have declined. Overexertion can result in a wide range of injuries ranging from traumatic injuries to joints, muscles and soft tissue to heart attacks. These injuries have increased in relative terms over the research period. All of these types of accidents can occur across sectors; however claims for drownings came only from the inshore fishery. Claims for accidents associated with contact with equipment have increased relative to the total number of accidents. With the decline of the offshore sector, accidents associated with contact with machinery have ceased, but as inshore activity has expanded and changed, accidents associated with commercial fishing equipment (e.g., crab pots, lines) have increased.

Through the linked database we can start to find out how these groupings of accidents and related injuries relate to different types of fisheries. Preliminary work indicates that in comparison to other commercial fishers, crab fishers experience relatively fewer accidents from slips and falls and overexertion but more accidents related to being caught in gear.

We are now preparing a pilot project using a small linked database to pre-test our methods before testing hypotheses generated from the NL WSHCC data and other projects in the study. For example, we are interested in what kinds of accidents and injuries are related to crab fishing in comparison to shrimp fishing: we want to know when and where these accidents occur in relationship to the trip cycle, and how fishing effort on these vessels changed over time and with what impact on fishing safety. For this pilot project we linked 28 WHSCC claims with 28 SAR incidents, and then successfully linked these cases to the DFO database. Through this process we can see the connections among the variables, identify the difficulties associated with integrating the databases, and perfect the techniques that must be used to handle these large datasets.

Conclusion and Future Directions

The linkages of the databases can occur in four ways: DFO with SAR; DFO with NL WHSCC; SAR with NL WHSCC; and DFO with SAR and NL WHSCC. It should be noted that there are SAR incidents that do not result in WHSCC claims, such as a person thrown overboard whom SAR recovers. Similarly, many WHSCC claims are not associated with SAR incidents, such as a person with a back problem caused by a slip on deck. However, a person caught and crushed in machinery on deck who is airlifted from the vessel and flown to the hospital will be included in both the SAR and WHSCC databases.

In theory, there should be a perfect match among the databases; however, we have identified a number of problems. The NLCHI identified 409 NL WHSCC claims representing 392 incidents or approximately eight percent of the database that could be linked. This low percentage was primarily due to the lack of recording of the fishing vessel name or vessel description in the database, mostly for company employees and in the later years of the study. Only 576 or eleven percent of claims had this information noted. In the case of the SAR data NLCHI identified 1,765 resources tasks representing 490 individual incidents or approximately seventeen percent of the database that could be linked (the SAR database only recorded cases from 1994 onwards). In this case, nearly eighty-six percent of the cases had either the vessel name or description recorded. Approximately thirteen percent of all fishing trips in the DFO database did not have the fishing vessel name or identifier recorded. The same percent of cases in the DFO database did not have the date the vessel set sail recorded. The systematic recording of data needed for linkage (notably fishing vessel number and/or fisher identification number) for all the databases has improved over time; however, throughout the study there was a systemic under representation of vessels under 35 feet. Since the full implementation of the dockside monitoring program in 1996, there has been more consistent recording of the catch, yet there is still much information, particularly date sailed and identifiers, not recorded especially for vessels under 35 feet. With the changes in recording this vital information, the potential for linking the databases has improved in more recent years, suggesting that in the future the linkage capacity and hence the capacity to trace patterns and trends will be stronger.

In order to put the information we are analysing in context, we are drawing on existing demographic and other secondary data to develop a profile of the fleet sectors in the province, the harvester population, the physical characteristics of different vessel types and lengths, and a profile of catches by species, location, and type of gear/technology. The fleet profile will include information on geographical distribution, vessel size, gear type/licenses, and crew size (if available). The harvester profile will include demographics, information on licenses, and information on incomes (if available). It will provide the basis for assessing the representativeness of samples involved in focus groups and interviews conducted as part of the Perceptions of Risk project. It will also allow us to make systematic comparisons of the types of vessels, the characteristics of crew, and the fishing activities associated with SAR incidents and NL WHSCC claims with those of the wider fleet. The addition of Environment Canada data to the linked database would allow us to identify weather conditions associated with higher incident rates, to select vessels or trips experiencing similar conditions, and to compare those that experienced claims or SAR incidents with those that did not. We have also identified a downward trend in the NL WHSCC claims in the fish-harvesting sector since 2001, which suggests that the bulge in claims and SAR incidents we saw in the late 1990s was a phenomenon that needs to be explored in more depth. With the capacity to obtain routine updates of the linked database every five years, dramatic improvements should be possible in our capacity to monitor long-term trends and the factors associated with them.

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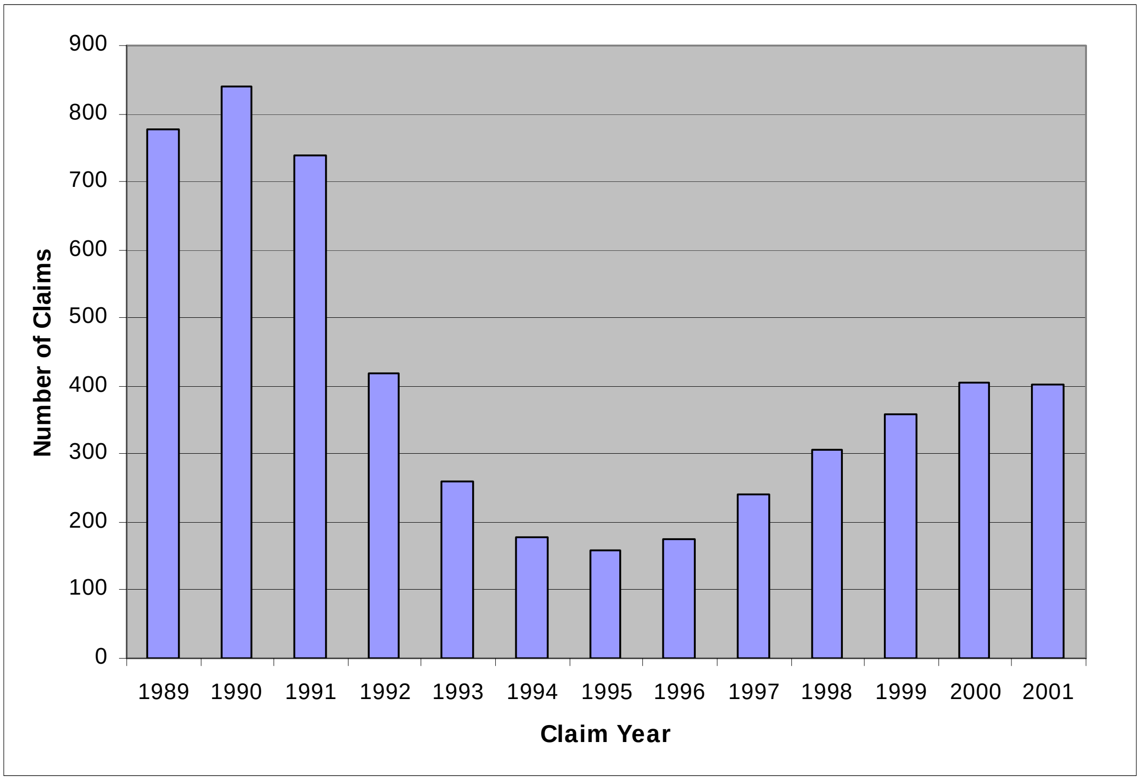

Figure 1: Distribution of Claims in the Fishing Industry from 1989 to 2001
N=5260, Missing Cases=0. Source: NL. WHSCC

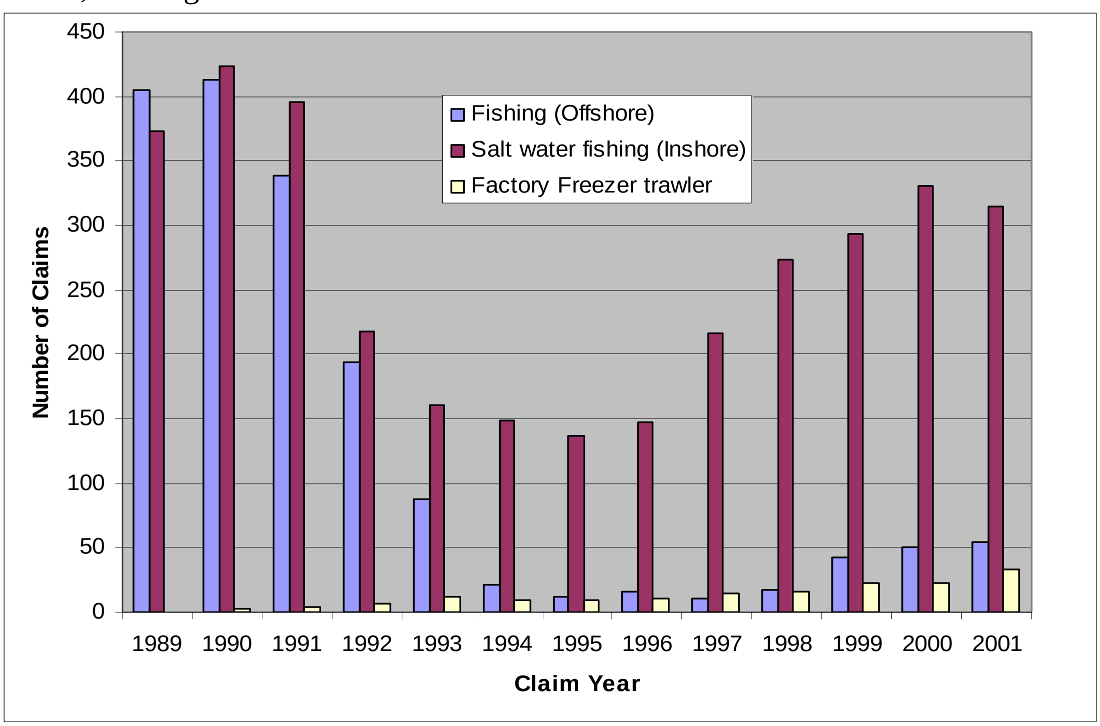

Figure 2: Distribution of Claims Broken Down by Fishery Sector 1989-2001.
N=5260, Missing Values=0. Source: NL WHSCC

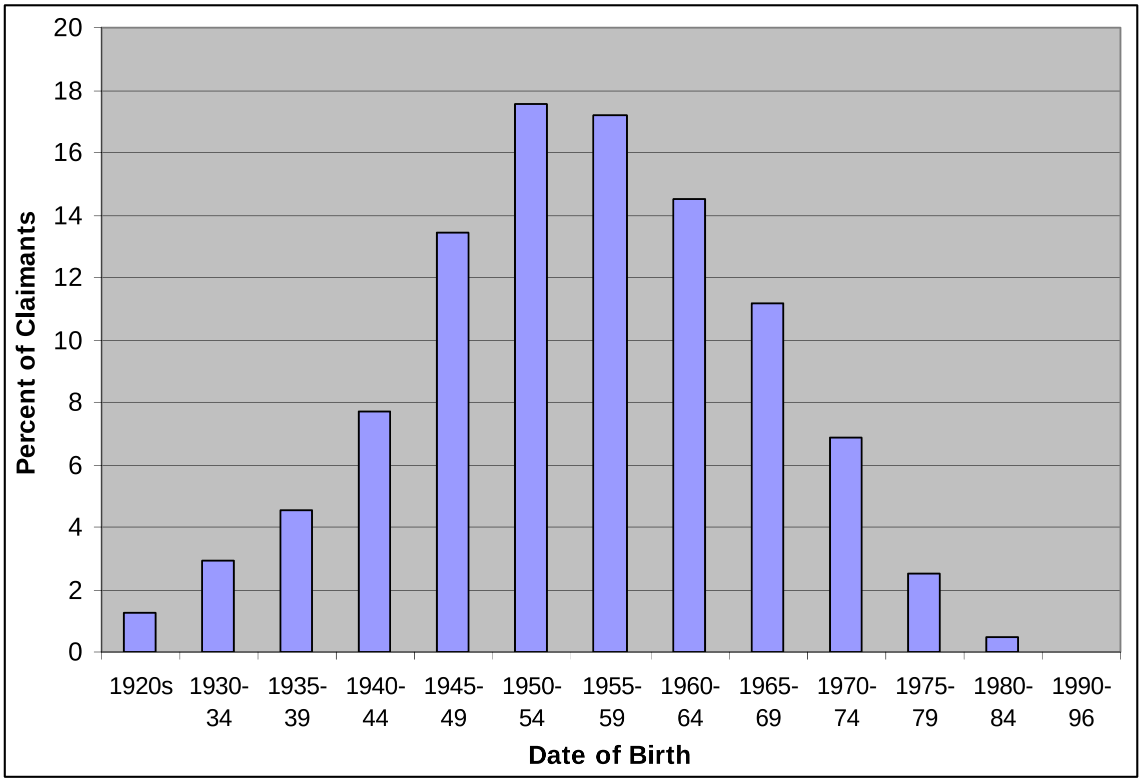

Figure 3: Distribution of Claimants by Birth Year in Five-year Cohorts (in percentages) N=4479, Missing Values=781. Source: NL WHSCC

	Inshore		Offshore		Trawler		All	
Nature of Injury	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Traumatic injuries to bones, nerves, spinal cord, cranium	298	10.8	51	4.0	9	6.5	358	8.6
Traumatic injury to muscles, joints, etc.	1055	38.1	644	50.8	29	20.9	1728	41.4
Open wounds	330	11.9	139	11.0	6	4.3	475	11.4
Surface wounds and bruises	372	3.4	266	21.0	21	15.1	659	15.8
Burns	21	0.8	12	0.9	0	0	33	0.8
Multiple traumatic injuries and disorders	55	2.0	16	1.3	3	2.2	74	1.8
Drowning	48	1.7	0	0	0	0	48	1.1
Non-specific injuries and disorders	263	9.5	66	5.2	33	23.7	362	8.7
Non-specific injuries and disorders: Back pain, hurt back	135	4.9	19	1.5	15	10.8	169	4.0
Nervous system and sense organ disorders	56	2.0	19	1.5	13	9.4	88	2.1
Musculoskeletal system and connective tissue disorder	50	1.8	20	1.6	0	0	70	1.7
Other	84	3.0	16	1.3	10	7.2	110	2.6
Total	2767*	100	1268**	100	139***	100	4174	100

Table 1: Distribution of Nature of Injury for all Claimants. N=4174, Missing Values=1086, *Missing Values = 669 **Missing Values=392 ***Missing Values =25. Source: NL WHSCC

	Inshore		Offshore		Trawlers		All	
Source of Injury	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Containers	286	12.4	128	10.8	6	8.3	420	11.8
Furniture and fixtures	13	0.6	18	1.5	<5	<5	32	0.9
Machinery	49	2.1	39	3.3	7	9.7	95	2.7
Commercial fishing equipment	138	6.0	9	0.8	7	9.7	154	4.3
Parts and Materials	377	16.3	232	19.7	9	12.5	618	17.4
Persons, plants, animals and minerals	72	3.1	33	2.8	<5	<5	107	3.0
Bodily motion or position of injured, ill worker	268	11.6	174	14.7	11	15.3	453	12.7
Structures and surfaces	257	11.1	234	19.8	11	15.3	502	14.1
Tools, instruments, and equipment	114	4.9	105	8.9	<5	<5	220	6.2
Vehicles – land	23	1.0	7	0.6	0	0	30	0.8
Water vehicles	416	18.0	75	6.4	6	8.3	497	14.0
Chemical and chemical products	8	0.3	5	0.4	0	0	13	0.4
Environmental elements	46	2.0	38	3.2	10	13.9	94	2.6
Other	242	10.5	83	7.0	<5	<5	326	9.2
Total	2309*	100	1180**	100	72***	100	3561	100.0

Table 2: Distribution of Source of Injury for all Claimants. N=3561, Missing Values=1699, *Missing Values= 1127 **Missing Values= 480 ***Missing Values= 92. Source: NL WHSCC

	Inshore		Offshore		Trawlers		All	
Type of Accident	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Contact with object/equipment: Struck against object	129	5.6	122	10.3	7	9.7	258	7.2
Contact with object/equipment: Struck by object	232	10.0	125	10.5	8	11.1	365	10.2
Contact with object/equipment: Caught in or compressed by object.	287	12.4	85	7.1	6	8.3	378	10.6
Contact with object/equipment: Rubbed or abraded by friction	115	5.0	111	9.3	<5	<5	227	6.4
Fall	334	14.5	250	21.0	13	18.1	597	16.7
Bodily reaction and exertion	260	11.3	167	14.0	9	12.5	436	12.2
Bodily reaction/exertion: Overexertion	569	24.6	269	22.6	7	9.7	845	23.7
Bodily reaction/exertion: Repetitive motion	15	0.6	0	0	<5	<5	17	0.5
Exposure to harmful subs. or environment	73	3.2	36	3.0	11	15.3	120	3.4
Exposure to harmful environment: Lost at sea	39	1.7	0	0	0	0	39	1.1
Transportation accidents (on land)	11	0.5	5	0.4	0	0	16	0.4
Transportation accidents (at sea)	240	10.4	19	1.6	6	8.3	265	7.4
Other	6	0.3	<5	<5	<5	<5	9	0.3
Total	2310*	100	1190**	100	72***	100	3572	100.0

Table 3: Distribution of Type of Accident for all Claimants. N=3572, Missing Values=1688, *Missing Values=1126 **Missing Values=470 ***Missing Values=92. Source: NL. WHSCC

Table 4: Distribution of Injured Body Part for all Claimants

	Inshore		Offshore		Trawlers		All	
Part of Body	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Head	71	2.1	53	3.2	6	3.7	130	2.5
Head: Ear(s)	36	1.0	22	1.3	11	6.7	69	1.3
Head: Eye(s)	83	2.4	48	2.9	7	4.3	138	2.6
Neck (incl. throat)	44	1.3	20	1.2	<5	<5	68	1.3
Trunk: Chest	387	11.3	186	11.2	18	11.4	591	11.2
Trunk: Back (incl. spine)	822	24.0	370	22.3	29	17.7	1221	23.2
Trunk: Lower Abdomen	100	2.9	66	4.0	<5	<5	169	3.2
Upper Extremities: Arm(s)	156	4.5	160	9.6	11	6.7	327	6.2
Upper Extremities: Wrist(s) and Hand(s)	349	10.2	154	9.3	9	5.5	512	9.7
Upper Extremities: Finger(s)	476	13.9	194	11.7	15	9.1	685	13.0
Upper Extremities: Multiple	48	1.4	10	0.6	<5	<5	59	1.1
Lower Extremities: Leg(s)	258	7.5	142	8.6	23	14.0	423	8.1
Lower Extremities: Ankle(s) and Feet	216	6.3	99	6.0	8	4.9	323	6.1
Lower Extremities: Multiple	39	1.1	8	0.5	0	0	47	0.9
Body Systems	47	1.4	5	0.3	<5	<5	56	1.1
Other	299	8.7	122	7.4	15	9.1	436	8.3
Total	3431*	100	1659**	100	164***	100	5254	100.0

N=5254, Missing Values=6, *Missing Values=5 **Missing Values= 1 *** Missing Values= 0 Source: Nfld. WHSCC

Table 5: Distribution of Nature of Injury over Time for all Claimants

	Accident year													
Nature of Injury	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Traumatic injuries to bones, nerves, spinal cord, cranium	32	39	43	34	13	9	12	15	25	39	35	29	33	358
Traumatic injury to muscles, joints, etc.	305	359	293	153	80	37	48	69	82	103	61	72	66	1728
Open wounds	82	83	68	36	16	17	7	17	18	28	40	33	30	475
Surface wounds and bruises	140	89	68	57	39	32	31	25	40	40	42	35	21	659
Burns	<5	7	5	<5	0	<5	<5	<5	<5	<5	0	<5	0	33
Multiple traumatic injuries and disorders	0	<5	11	12	<5	<5	<5	5	12	7	5	6	6	74
Drowning	7	0	<5	<5	<5	8	<5	<5	<5	5	<5	8	<5	48
Non-specific injuries and disorders	0	0	0	<5	0	0	0	0	7	13	88	121	132	362
Non-specific injuries and disorders: Back pain, hurt back	0	0	0	0	<5	<5	0	0	0	6	37	59	65	169
Nervous system and sense organ disorders	0	<5	0	<5	5	0	<5	<5	8	11	17	10	25	88
Musculo-skeletal system and connective tissue disorder	<5	11	10	<5	<5	<5	<5	<5	<5	<5	13	11	<5	70
Other	<5	10	11	5	8	<5	<5	<5	6	20	9	15	17	110
Total	575	602	512	308	170	110	117	146	205	277	348	403	401	4174

N=4174, Missing Values=1086, Source: Nfld. WHSCC

Table 6: Distribution of Source of Injury over Time

	Accident year													
Source of Injury	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Containers	57	65	57	29	22	17	12	25	10	25	30	36	35	420
Furniture and fixtures	7	8	4	<5	<5	0	0	<5	<5	<5	<5	<5	0	32
Machinery	14	19	19	11	<5	5	5	<5	5	<5	<5	<5	<5	95
Commercial fishing equipment	0	0	<5	0	0	0	0	0	21	23	33	38	38	154
Parts and Materials	80	137	139	64	34	18	15	18	24	20	25	27	17	618
Persons, plants, animals and minerals	17	17	21	14	6	<5	<5	<5	<5	<5	<5	6	<5	107
Bodily motion or position of injured, ill worker	56	72	48	53	19	10	19	23	22	38	29	43	21	453
Structures and surfaces	70	139	115	37	39	14	12	19	9	15	12	13	8	502
Tools, instruments, and equipment	54	50	42	19	11	7	<5	<5	<5	5	9	6	7	220
Vehicles - land	7	0	9	<5	<5	<5	<5	<5	0	<5	<5	<5	0	30
Water vehicles	85	28	31	32	9	5	10	11	36	51	70	60	69	497
Chemical and chemical products	0	9	<5	0	0	0	0	0	0	<5	0	<5	0	13
Environmental elements	11	8	<5	<5	<5	<5	<5	<5	<5	12	11	8	20	94
Other	112	45	22	37	20	26	14	12	<5	10	6	13	5	326
Total	570	597	513	305	170	109	98	122	146	212	234	258	227	3561

N=3561, Missing Values=1699, Source: Nfld. WHSCC

Table 7: Type of Accident in Claims over Time

	Accident year													
Type of Accident	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Contact with object/equipment: Struck against object	47	44	38	31	8	15	7	8	8	12	14	13	13	258
Contact with object/equipment: Struck by object	40	59	73	26	13	16	7	14	24	17	30	24	22	365
Contact with object/equipment: Caught in or compressed by obj.	62	49	37	41	19	11	14	16	18	27	29	31	24	378
Contact with object/equipment: Rubbed or abraded by friction	96	58	21	22	11	5	<5	<5	<5	<5	<5	<5	<5	227
Fall	102	142	136	51	46	20	23	23	12	13	10	7	12	597
Bodily reaction and exertion	68	65	48	48	21	10	19	23	15	37	23	41	18	436
Bodiliy reaction/exertion: Overexertion	145	167	139	78	41	22	17	28	24	36	38	61	49	845
Bodily reaction/exertion: Repetitive motion	0	0	0	0	0	0	0	0	<5	<5	6	<5	<5	17
Exposure to harmful subs. or environment	13	13	9	8	6	<5	5	<5	5	14	12	10	19	120
Exposure to harmful environment: Lost at sea	0	0	<5	0	<5	8	<5	<5	<5	5	<5	8	<5	39
Transportation accidents (on land)	0	0	8	<5	<5	0	0	<5	0	<5	<5	0	0	16
Transportation accidents (at sea)	<5	0	0	0	0	0	0	<5	31	46	66	57	62	265
Other	0	<5	0	0	0	0	<5	<5	0	<5	0	<5	<5	9
Total	574	601	512	307	170	109	97	124	146	213	234	258	227	3572

N=3572, Missing Values=1688, Source: Nfld. WHSCC

Table 8: Distribution of Injured Body Part in Claims over Time

	Accident year													
Part of Body	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Head and Neck	64	47	34	25	17	13	12	10	20	39	42	40	42	405
Trunk	280	326	291	160	102	62	63	71	76	102	139	160	149	1981
Upper Extremities	277	279	240	134	73	54	35	43	77	69	92	106	104	1583
Lower Extremities	115	129	114	60	38	25	27	31	49	49	52	50	54	793
Body Systems	9	10	<5	<5	7	9	<5	<5	<5	<5	<5	<5	<5	56
Other	31	49	58	38	23	16	15	14	17	45	33	47	50	436
Total	776	840	739	419	260	179	156	173	242	306	359	404	401	5254

N=5254, Missing Values=6, Source: Nfld. WHSC