# *Chapter 4. Goal 2: Priority Populations at Risk*

**Research Goal 2:** Reduce injuries, illnesses, and fatalities among subgroups of the working population determined to be at high risk or underserved by traditional occupational health approaches.

## 4.1 Child Labor

**4.1 Goal:** Protection of children living and working on farms, Understanding the Exposures: Reduce injuries, illnesses, and fatalities among children working on farms.

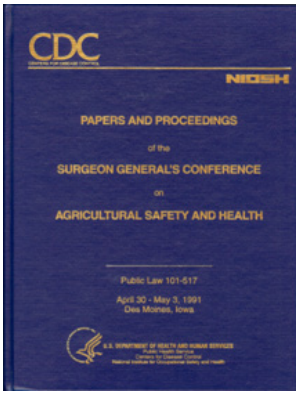
### 4.1a Challenge or Issue

The problem of children being injured while living, working, or visiting agricultural work environments (primarily farms) has been recognized for several decades. Youth deaths on farms during the 1980s averaged more than 100 per year (Figure 4-1), while nonfatal injuries during this same time period were estimated to occur to as many as 100,000 farm youths per year [NCCAIP 1996, Adekoya and Pratt 2001]. During the early 1990s, national surveillance data maintained by the BLS identified an average of 70 workplace fatalities per year among workers under age 18 [Derstine 1994] (Figure 4-1). The BLS data showed that the majority of the deaths of youths under age 16 and one-fourth of the deaths of youths aged 16 and 17 were in the agriculture industry. In addition, youths working on farms were suspected of having increased risks for cumulative trauma MSDs. Surveillance data on occupational injuries and illnesses among young workers has been sparse for many years. In 1998, nearly two million youths under age 20 lived or worked on a farm in the United States [Myers and Hendricks 2001].

Another challenge is that regulatory activity to improve safety and health for youths employed in agriculture has been uneven and neglected. Goal 2: Priority Populations at Risk Fair Labor Standards Act (FLSA) defines work activities prohibited for young workers through Hazardous Orders (HOs), 11 of which apply to agricultural occupations. No changes of any kind have been made to the agricultural HOs since 1970, despite far-reaching shifts in the agricultural production industry in terms of levels of mechanization, use of pesticides and herbicides, livestock handling practices, production demands, marketing practices, and labor arrangements. In addition, none of the HOs addresses MSDs or their associated risks. HOs for agricultural occupations applied only to youths under age 16, leaving older teens unprotected. Finally, youths working on their own family farms were exempted from child labor laws, apparently excluding a large proportion of working youths from safety and health protections.

### 4.1b Activities

**Beginnings of the Childhood Agricultural Injury Prevention Initiative**




In 1991, the Surgeon General's Conference on Agricultural Safety and Health included a session that highlighted the risks faced by persons, young and adult, involved with production agriculture [Myers, et al. 1992]. In the following year a Childhood Agricultural Injury Prevention symposium sponsored by the National Farm Medicine Center sought to develop consensus on research, education, policy, and other interventions to reduce agricultural injuries among children [Lee and Gunderson 1992].

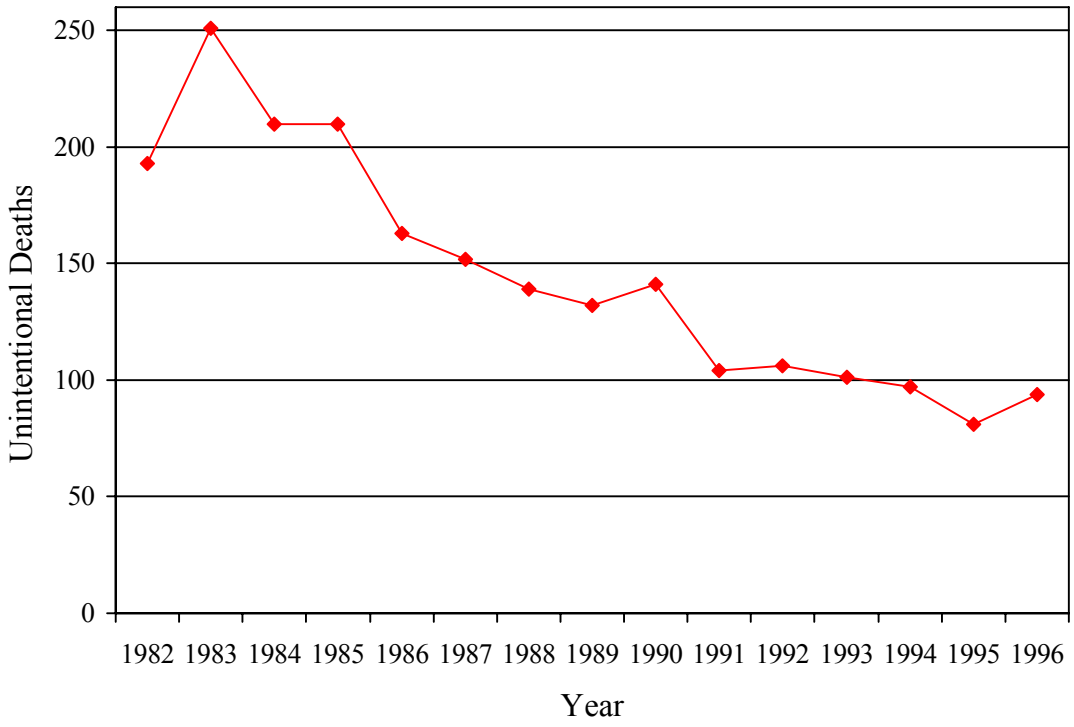
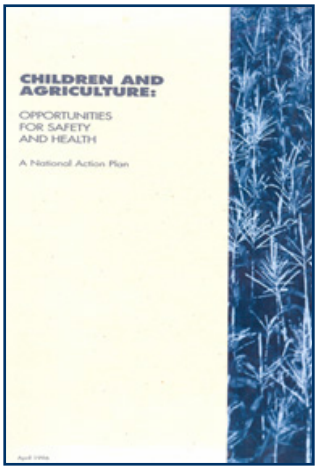



**Figure 4-1:** Unintentional farm deaths to youths under age 20, 1982–1996.
*Source: National Center for Health Statistics, National Vital Statistics System.*

In 1995, the National Farm Medicine Center sponsored another conference, this one on Child and Adolescent Rural Injury Control. An outgrowth was the establishment of the NCCAIP, representing a core group of 42 persons from national organizations, as well as authorities in childhood agricultural injury or disease prevention and two scientists from the AFF Program. Chaired by Dr. Barbara Lee of the National Farm

Medicine Center, this committee finalized a national action plan to address childhood injuries on farms.




The final NCCAIP document, released in 1996 [NCCAIP 1996], specifically recommended that NIOSH serve as the lead Federal agency in preventing childhood agricultural injury. On the basis of this report, Congress appropriated the AFF Program $5 million in Fiscal Year 1997 to implement the NCCAIP plan, thus giving rise to the Childhood Agricultural Injury Prevention Initiative.

As part of the planning process, a public meeting was held in 1997 to allow stakeholders to comment on the AFF Program plan for implementing the Initiative. Twenty-three persons attended, representing farm families, a farm worker organization, an insurance agency, an equipment manufacturer, safety advocates and educators, researchers, and key Federal agencies. Participants stressed that surveillance should cover as many youth populations as possible; including young migrant and seasonal farm workers and youths visiting farms in the United States.

To implement the initiative, the AFF Program has allocated 75% of the appropriated funds to the extramural grant process and 25% for intramural NIOSH activities. Extramural funds have been directed primarily towards addressing research and outreach, while intramural funds have been used predominantly to support surveillance activities.

## Childhood Agricultural Injury Surveillance

In response to comments from the 1997 public meeting, the AFF Program held a separate peer review meeting that year to gather more input into its surveillance options. Comments came from extramural researchers and representatives of potential partners in surveillance efforts, including USDA, NASS, and CPSC.

The peer review panel concluded that additional surveillance efforts by the AFF Program for occupational fatal injury of youths on farming operations was not required, since adequate work-related fatality surveillance was provided by BLS CFOI. For general youth fatality information for farms, the AFF Program proposed using the NCHS National Vital Statistics System (NVSS) data files, and collecting death certificates from vital statistics reporting agencies meeting specific criteria. These data would then be used to define the general fatality and nonoccupational fatality issues faced by youths on farms. The panel agreed this was a reasonable approach.

NVSS
National Vital Statistics System

For nonfatal injuries, the panel concluded that the populations of interest for surveillance fell into the following three main groups: 1) children of farm operators, 2) young farm workers and the children of farm workers, and 3) children visiting farming operations. For farm family youths, the panel recommended that the AFF Program take special care to ensure that minority youths were adequately covered in any final surveillance plan.

The panel examined a range of surveillance options but found none of them ideal. They concluded that no single surveillance approach would adequately cover all the populations of interest. As a result, the AFF Program decided to pursue a variety of methods of obtaining population-specific childhood agricultural injury data, to assess how each system worked, and to examine the possibility of using a combination of surveillance methods to find representative data sources of nonfatal injuries for each group.

**Nonfatal Injury Surveillance**

To date, the AFF Program has assessed three existing surveillance or survey systems (the CPSC NEISS, the NCHS NHIS, and the DOL NAWS) for their potential to track childhood agricultural injuries and two new methods to fill gaps in existing systems [using Health Resources Service Administration (HRSA) lay health advisors to collect injury information for migrant and seasonal farm youths and farm operator telephone surveys through the USDA, NASS]. Because of low capture rates and technical problems, the AFF Program ruled out using the NCHS NHIS survey and the HRSA lay health advisor model. This decision left three surveillance methods for nonfatal childhood agricultural injuries: NAWS, CAIS and NEISS. (Appendices 4.1-01, 4.1-02, 4.1-03)

NAWS – NAWS [DOL 2006] is a personal interview survey of 3,400 predominantly migrant and seasonal farm workers across the United States each year. In 1999, the AFF Program pilot tested the use of a farm injury module within NAWS. The module was asked of all farm workers in the NAWS sample, including workers under age 20. Workers were asked about work or nonwork injuries that occurred to them on a farm in the last 12 months. Details about the injuries were collected for all positive responses. The initial results of this pilot study found that youths under age 20 accounted for 14% of the migrant and seasonal farm worker workforce, and 6% of the total farm-related injuries in this special population (Figure 4-2). The initial results from NAWS led the

**Table 4-1. Injuries to youths under age 20 that occurred on U.S. farms during 1998, 2001, and 2004, by sex and work status.**

| Injuries | 1998 | 2001 | 2004 |
|---|---|---|---|
| Total injuries* | 37,774 | 29,207 | 27,590 |
| | | | |
| Male | 29,564 | 16,526 | 14,390 |
| Female | 8,210 | 12,641 | 13,201 |
| | | | |
| Work | 16,695 | 9,481 | 8,130 |
| Nonwork | 18,169 | 19,611 | 19,439 |

*Total injuries may not add because of rounding or missing data. *Source: NIOSH CAIS*

AFF Program to provide the DOL additional funds to collect the injury module in the 2002–2004 NAWS (Appendix 3.2-03). These data are currently being analyzed.

CAIS - The second surveillance approach pursued by the AFF Program is CAIS, a series of farm operator surveys conducted for the Program by the USDA, NASS. CAIS covers youths who live on, work on, or visit farms in the United States. Each round of CAIS is based on a telephone survey of 50,000 farm operations selected at random across the United States. Farm operators are asked about the total number of nonfatal injuries that occurred to youths under age 20 on their farms in the preceding calendar year. Details about all injuries are collected for positive responses. Demographic data on farm household youths and youths directly hired to work on the farm are also collected.

To date, CAIS data have been collected for calendar years 1998, 2001, and 2004. These results have allowed the AFF Program to track the number of youth farm injuries over time (Table 4-1).

Significant findings to date from CAIS include a decrease in the number of childhood agricultural injuries reported by farm operators between 1998 and 2004, with the largest decrease occurring among young males. Injury rates for farm household youths decreased the most in the Northeast and the South, with the Midwestern States showing the smallest decrease in injury rates (Figure 4-3). Nonwork-related injuries account for the largest proportion of these farm injuries to youths and they have not been decreasing with time (Table 4-1). Finally, the number of females injured on farms has been increasing over time.


**Figure 4-2.** Percentage distributions of the injuries and workforce by age for migrant and seasonal farm workers in the United States, 1999. *Source: DOL NAWS*

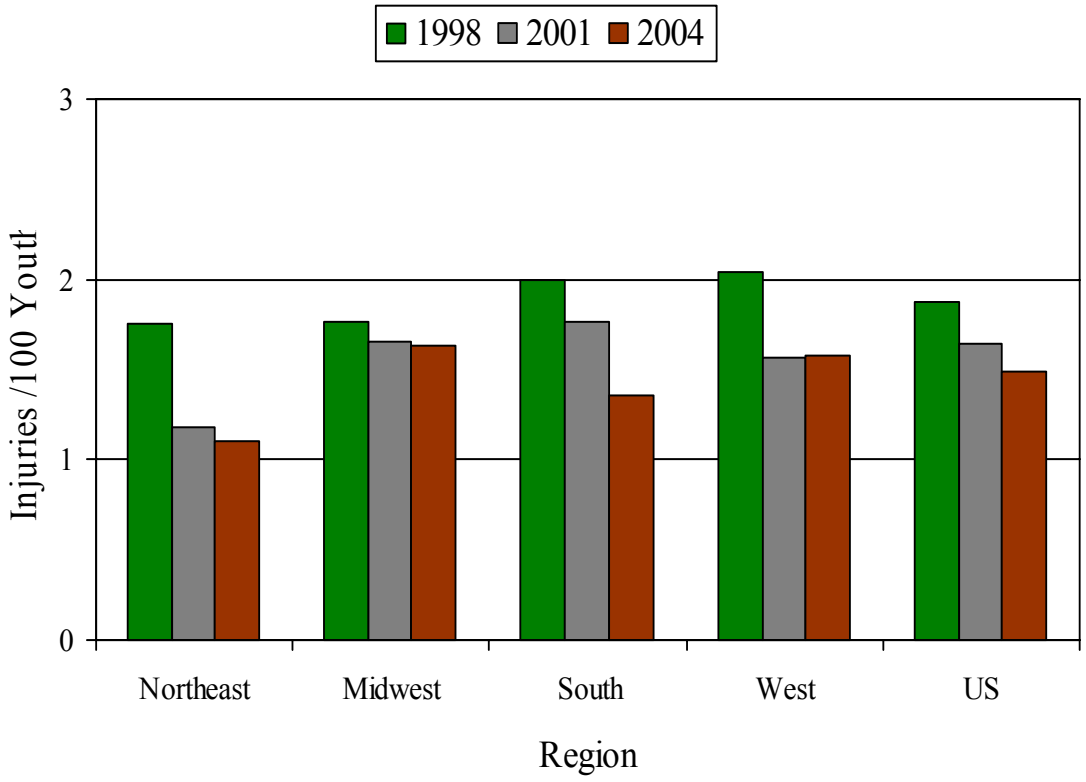



**Figure 4-3:** Farm Injuries per 100 household youths by region, 1998, 2001, and 2004. *Source: NIOSH CAIS*

Results of the initial 1998 CAIS verified the concerns of the 1997 surveillance review panel that minority youths living on farms would not be adequately covered by a random sample of all farms in the United States. To address this gap, the AFF Program approached NASS to conduct a more focal CAIS survey for minority farm operations made possible through its list of minority farm operations from the 1997 Census of Agriculture. In 2001, NASS completed the first M-CAIS for the AFF Program, covering injuries to youths on racial minority and Hispanic-operated farms during calendar year 2000. A second round of M-CAIS has been conducted for the calendar year 2003 (NASS requires the AFF Program to report racial minority and Hispanic estimates separately).

The youths farm injury estimates for racial minority farms from M-CAIS show patterns similar to those seen in CAIS. The total youths injuries on racial minority farms and injuries to males decreased slightly between 2000 and 2003, with injuries to females increasing (Table 4-2). Injury rates for household youths on racial minority farming operations did not change significantly over this time period (12.2 injuries per 1,000 household youths in 2000 to 12.6 injuries per 1,000 household youths in 2003).

A significant finding from the M-CAIS has been that household youths on Native American farming operations have the highest farm-related injury rate of all farm household youths (Figure 4-4).

For Hispanic farm operations, the total number of injuries increased slightly, as did the number of injuries due to work (Table 4-3). However, during this time period M-CAIS estimated that the number of youths on Hispanic farms increased by 59%. The upshot is that injury rates decreased 32% for household youths on Hispanic farms in the United States (14.2 injuries per 1,000 household youths in 2000 down to 9.7 injuries per 1,000 household youths in 2003).

**Table 4-2. Injuries to youths under age 20 that occurred on racial-minority-operated farms in the United States during 2000 and 2003, by sex and work status.**

| Injuries | 2000 | 2003 |
|---|---|---|
| Total injuries* | 653 | 627 |
| | | |
| Male | 470 | 384 |
| Female | 181 | 227 |
| | | |
| Work | 245 | 228 |
| Nonwork | 402 | 378 |

* Total injuries may not add up due to rounding. *Source: NIOSH M-CAIS*

NEISS - The AFF Program continues to use the CPSC NEISS as part of the Childhood Agricultural Injury Prevention Initiative [CPSC 2006]. NEISS is an Emergency Department (ED)-based system used to monitor occupational injuries in the United States. Specifics on the NEISS are provided in Chapter 3.

In 1998, NIOSH published an analysis of NEISS cases (October 1995 through September 1997) involving agricultural work-related injuries to youths under age 20 [Adekoya et al. 1998]. The report estimated an average of 5,400 work-related agricultural injuries to youths each year. The relatively low number of cases and the limited information available within NEISS precluded in-depth analyses.

To collect more information, the AFF Program conducted telephone follow-back interviews of youths injured on farms. Cases were selected for follow-back if the injury occurred on a farm, involved sources of injury thought to be associated with farm activities (e.g., tractors, barb wire, agricultural machines, hay bales), or had been identified as a probable farm injury based on the ED narrative of the injury. A total of 423 surveillance cases were identified between June 1, 1998 and September 30, 1999. Follow-back interviews were completed for 245 cases (58%). Of the 245 completed interviews, 129 respondents indicated that their injury occurred on a farm.

**Table 4-3. Injuries to youths under age 20 that occurred on Hispanic operated farms in the United States during 2000 and 2003, by sex and work status.**

| Injuries | 2000 | 2003 |
|---|---|---|
| Total Injuries * | 366 | 434 |
| | | |
| Male | 262 | 314 |
| Female | 104 | 120 |
| | | |
| Work | 140 | 167 |
| Nonwork | 226 | 267 |

*Source: NIOSH M-CAIS*

### Fatal Injury Surveillance

Occupational fatality surveillance is provided through the BLS CFOI [BLS 2006] and through the NIOSH FACE program [NIOSH 2006]. Details on CFOI and FACE are provided in Chapter 3. (Appendices 3.3-01, 3.3-02)

As a result of NIOSH FACE emphasizing youths and agriculture as priority areas, AFF researchers have investigated five youth fatalities on farms since 1989 and State FACE programs have investigated 29 youth fatalities on farms since 1992. These case-based investigations allow for a more in-depth understanding of the causes of these deaths and the development of cause-specific prevention recommendations than may be possible from other large scale surveillance studies.

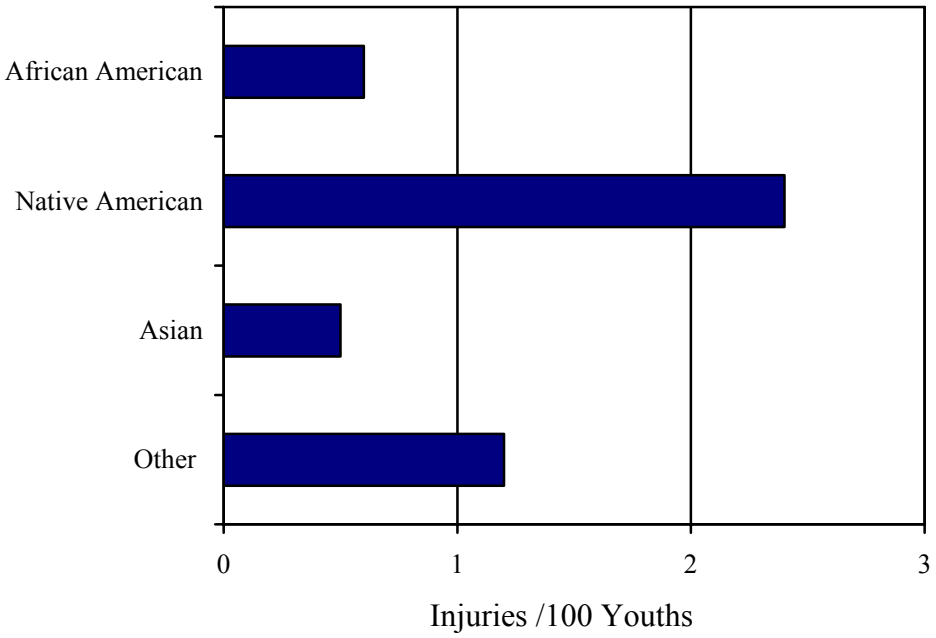



**Figure 4-4:** Farm injuries per 100 household youths by race, 2000. *Source: NIOSH M-CAIS*

The AFF Program has conducted two separate analyses of the CFOI during the initiative [Castillo, et al. 1999, Hard and Myers 2006]. The main finding from these analyses is that youths working on farms have occupational fatality rates 3 to 4 times higher than the national average occupational fatality rate for all working youths (14.6 deaths per 100,000 working youths on farms verses 3.6 deaths per 100,000 working youths during the time 1997–2002). These studies show that the annual number of deaths to youths working on farms decreased between 1992 and 2002, but that fatality rates have not decreased, and have even increased over the same time

period for youths aged 15–19 (Table 4-4). The leading source of these fatalities was farm tractors, accounting for 27% of the deaths.

CFOI and FACE only provide information about occupational fatalities. To assess all deaths occurring on farms, the AFF Program reviewed mortality data from the NCHS for the years 1982 through 1996 [Adekoya 2001]. Farm deaths were identified by the location of injury code provided in the NCHS file. The analysis found that the number of fatalities to youths on farms decreased during the study period, with the biggest decrease occurring from deaths associated with machinery (Figure 4-5). The report also found that after machinery, the leading causes of death for youths on farms were drowning and firearms. Since the release of these data, six additional years of NCHS fatality data have become available. The AFF Program will update this document with the new years of data.

**Table 4-4. Rates per 100,000 FTE of fatal work-related injuries for workers aged 15–19 for all industries and the agricultural production industry in the United States, 1992–1996 and 1997–2002.**

| Age (Years) | All Industries | | | Ag Production | | |
|---|---|---|---|---|---|---|
| | 1992–1996 Rate | 1997–2002 Rate | % Change | 1992–1996 Rate | 1997–2002 Rate | % Change |
| **15** | 5.2 | 5.1 | -1.9 | 13.3 | 24.1 | 81.2 |
| **16** | 3.6 | 2.8 | -22.2 | 10.5 | 15.2 | 44.8 |
| **17** | 3.5 | 2.9 | -17.1 | 16.8 | 12.9 | -23.2 |
| **18** | 4.1 | 3.4 | -17.1 | 12.0 | 10.3 | -14.2 |
| **19** | 4.4 | 4.0 | -9.1 | 11.8 | 14.6 | 23.7 |
| **Total** | 4.1 | 3.6 | -12.2 | 12.8 | 14.6 | 14.1 |

*Numbers and rates were calculated by NIOSH and may differ from previously published BLS CFOI numbers and rates. *Source: BLS CFOI*

One problem identified with NCHS mortality data is that, due to International Classification of Diseases (ICD) coding rules, the location variable is only provided for nontransportation, unintentional injuries. As a result, farm fatalities involving off-roadway traffic events and intentional causes of death are not identifiable from the NCHS mortality files. To address this issue, the AFF Program began collecting death certificates for all on-farm fatalities for youths under age 20 from all States. To date, death certificates have been collected through calendar year 2004. A preliminary analysis of this death certificate data for the years 1995–2000 [Goldcamp et al. 2004] has revealed that nearly 31 % of the deaths to youths on farms were due to either transportation or intentional causes of death (Figure 4-6). In addition, the study found suicide was the leading cause of death for youths aged 16–19 on farms.

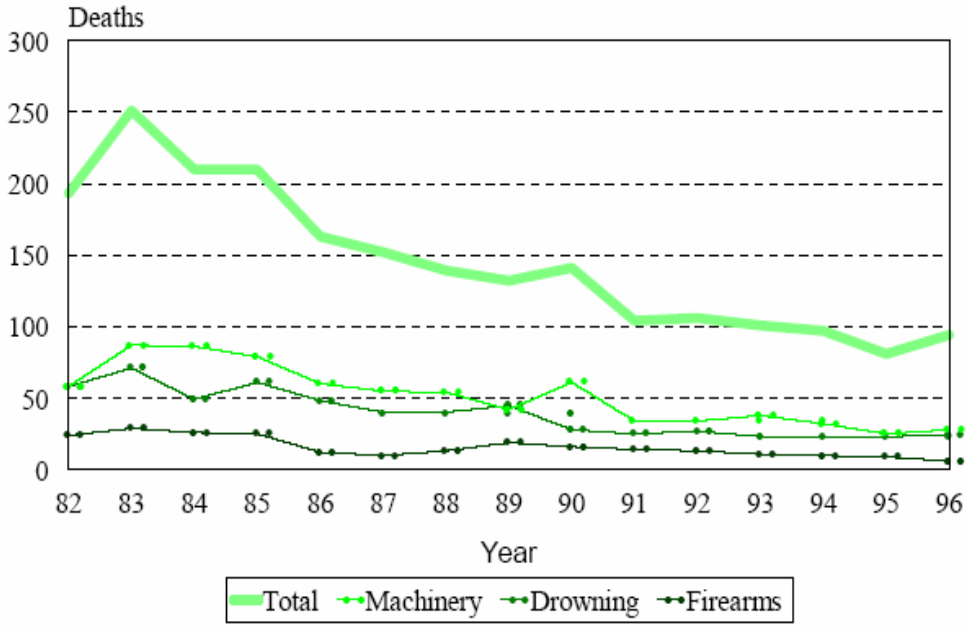
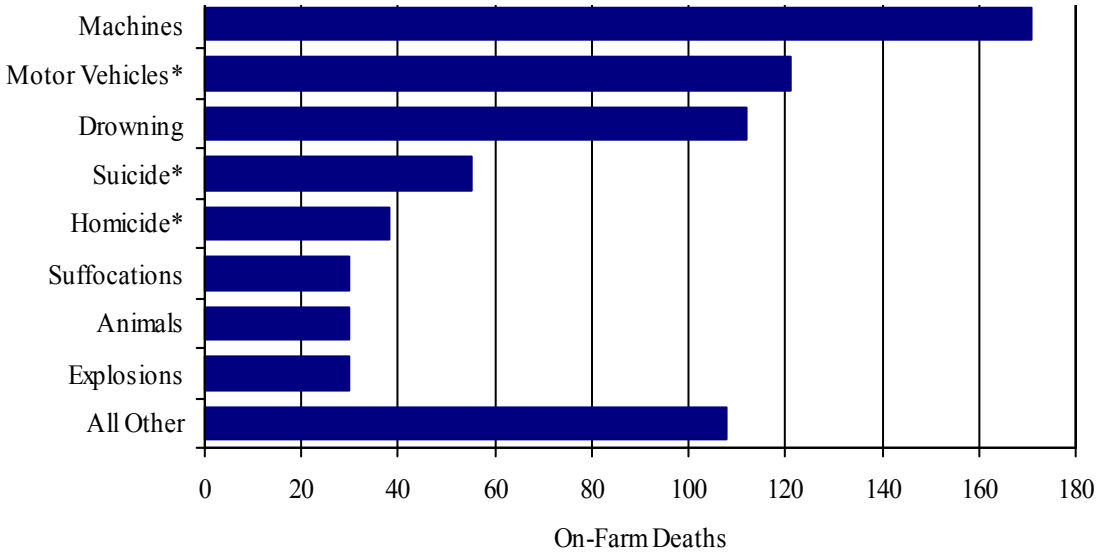



**Figure 4-5:** Trend of the leading causes of fatal farm injuries to persons under age 20 in the United States, 1982–1996. *Source: NCHS NVSS.*




F**igure 4-6:** Cause of death for youths under age 20 on U.S. farms, 1995–2000. * On-farm deaths not reported by NCHS NVSS. *Source: NIOSH, Childhood Agricultural Mortality System*

**Childhood Agricultural Musculoskeletal Disorder Research**

Before 1998, little research had been conducted on the risk of MSDs for youths and adolescents working in agriculture. The few studies that had evaluated the risk of chonic MSDs among youths workers showed that many jobs performed by youths and adolescents on farms would be considered high risk for low back disorders for adults [Allread et al. 2004]. The risk of MSDs was thought to be even greater for youths and adolescents who perform these jobs compared to adult workers. To begin assessing the actual MSD risks of youths working on farms, the AFF Program initiated a childhood agricultural MSD research program in 1998. (Appendices 4.1-04, 4.1-05)

This progam of research encompassed several individual projects and activities including the following:

- In 1999, a literature review examined what was known about the potential risk of MSDs for youths working in agriculture.
- In 1999, a project conducted focus groups with farm parents, farm youths, and farm employers to obtain information about perceptions of risk of MSDs for youths working on farms and high risk tasks.
- In 2000, a project was initiated to develop and evaluate a clinic-based surveillance system for documenting ag-related MSD cases for youths.
- In 2001, a project began that focused on developing a biomechanical model to assess the physical stress for youths performing manual material handling jobs on farms.
- In 2001, a project was intiated to assess the risk of low back pain associated with various manual material handling tasks performed by youths on farms.
- In 2002, a conference was organized to seek input from experts on research gaps for prevention of MSDs for youths working in agriculture.
- In 2002, a study was conducted to obtain information about hours of work from youths working on farms.
- In 2002, a project was initiated to compare bone mineral content and bone stiffness in farm youths versus nonfarm youths to determine whether there may be early indicators for potential long-term effects for farm youths due to stiffer bones resulting from heavy physical labor on farms.
- In 2003, a series of studies was inititated to develop and evaluate ergonomic interventions designed to reduce the physical demands of specific high risk tasks.

Findings from these activities confirmed that MSDs are a problem for youths working on farms. Task assessments have concluded that a high percentage of jobs performed by youths on farms place them at high risk for low back pain. This work also identified a number of research gaps in preventing MSDs for youths working in agriculture. The AFF Program and its partners will continue to look at interventions to reduce the risk of MSDs for youths working on farms, and to develop or modify exposure assessment methods to assess the MSD risks among youths and adolescents.

**Child Labor Hazardous Orders for Youths Working in Agriculture**

On October 25, 1994, the AFF Program submitted comments to DOL in response to an advance notice of proposed rulemaking for child labor [NIOSH 2002] (Appendices 4.1-06, 4.1-07, 4.1-08). In its comment, the AFF Program provided the following recommendations for new HOs for nonagricultural industries and agriculture:

- Work in which youths are exposed to a hazard of falling six feet or more
- Work in confined spaces
- Work in which youths may come into direct or indirect contact with circuitry and equipment for electrical power distribution and use.

The following recommendations were made for new HOs for agriculture:

- Farm work with all-terrain vehicles
- Working alongside machinery with power take-offs or similar rotating drivelines.

In the same document, the AFF Program offered additional recommendations for strengthening child labor regulations:

- DOL should establish a mechanism by which child labor regulations are reviewed on a routine basis to ensure that the safety and health goals of these regulations are being achieved.
- DOL should ensure that youths are adequately represented in data collection efforts within DOL so that patterns of employment and injury can be routinely analyzed to support the administration of child labor laws. Employment data needed to estimate the size and characteristics of worker groups are available only for workers aged 15 and older, which is a serious deficiency for risk analysis for youths employed in agriculture.
- DOL should consider an amendment to the Fair Labor Standards Act to raise the minimum age for HOs in agriculture from 16 to 18 years. Youths in agriculture are permitted to do hazardous work at age 16, while those in nonagricultural occupations are not permitted to do hazardous work until age 18. The AFF Program noted that this distinction is justified only if agricultural work is demonstrably less hazardous. To the contrary, data on fatal and nonfatal injuries have consistently shown agriculture to be one of the most hazardous industries for workers of all ages.
- DOL should consider an amendment to the Fair Labor Standards Act to remove exemptions from child labor provisions in agriculture for youths employed by their parents (or persons standing in their place) with regard to provisions against hazardous work. Youths employed in nonagricultural occupations are not permitted to do work prohibited by HOs, even if employed by their parents. This is not the case in agriculture, where youths may perform any task while working on their family's farm. The AFF Program also noted that the absence of data on injuries to youths working on

> family farms was an impediment to accurate assessment of differences in safety and health risks for youths employed as family workers versus hired workers.

Recognizing the need for a comprehensive review of youths employment that would encompass patterns of work by youths, the relationship between employment and educational achievement, safety and health risks for working youth, and the psychosocial effects of employment, the AFF Program requested that the Board on Children, Youth, and Families of the National Research Council conduct a study of the safety and health implications of youths employment. Support for the study came from the AFF Program, the Robert Wood Johnson Foundation, the U.S. EPA, the National School-to-Work Office, the DOL, Employment Standards Administration (ESA), and the Maternal and Child Health Bureau of the U.S. DHHS. The AFF Program also provided substantial technical assistance to the 16-member committee charged with conducting the study. Results of the study were published in 1998 by the National Research Council, Institute of Medicine as *Protecting Youths at Work: Health, Safety, and Development of Working Children and Adolescents in the United States*. A full chapter in this monograph is devoted to the unique work setting and occupational hazards for youths employed in agriculture. In addition, the monograph made the following recommendation, which encompassed all types of work for youths:

> "The U.S. Department of Labor should undertake periodic reviews of its hazardous orders in order to eliminate outdated orders, strengthen inadequate orders, and develop additional orders to address new and emerging technologies and working conditions. Changes to the hazardous orders should be based on periodic reviews by the National Institute for Occupational Safety and Health of current workplace hazards and the adequacy of existing hazardous orders to address them" [National Research Council 1998].

In response to the recommendation in this monograph, DOL provided funds for the AFF Program to develop a report on the adequacy of HOs, based on a review of data and the scientific literature. The report was developed as a deliverable in interagency agreements between the AFF Program and DOL ESA in Fiscal Years 1999 to 2001. (ESA is the part of DOL that is directly responsible for developing and enforcing child labor laws). In addition to reviewing hundreds of scientific articles and reports, the AFF Program used the CFOI, SOII, NEISS, the Traumatic Injury Surveillance of Farmers survey, the CAIS, and the Current Population Survey as primary data sources. AFF Program staff resources were devoted to analyzing and interpreting data and preparing the report. They also provided supporting data. Because the agriculture industry has its own set of HOs, a large portion of this review focused on youths working on farms in the United States. (Table 4-5). In addition, a new HO was recommended by the AFF Program concerning respirator use by youths working in both agricultural and nonagricultural work settings. The final report was provided to ESA in early spring of 2002 [NIOSH 2002].

**Table 4-5. Summary of NIOSH Recommendations Pertaining to Existing Agricultural Occupation HOs, 2002**

| Existing Agricultural HO | Retain | Revise | Specific Recommendations |
|---|---|---|---|
| HO 1: Operating a tractor more than 20 PTO horsepower or connecting or disconnecting an implement or any of its parts to or from such a tractor | | X | (1) Revise to remove the 20 PTO (power take-off) horsepower thresholds; (2) revise exemption for youths aged 14-15 with tractor certification to require tractors to be equipped with a ROPS and mandate the use of seatbelts. |
| HO 2: Operating or assisting to operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the operation) any of the following machines: corn picker, cotton picker, grain combine, hay mower, forage harvester, hay baler, potato digger, or mobile pea viner; feed grinder, crop dryer, forage blower, auger conveyor, or the unloading mechanism of a nongravity-type self-unloading wagon or trailer, or power post-hole digger, power post driver, or nonwalking-type rotary tiller | | X | Combine HO 2 and HO 3 and expand prohibition from lists of specific machines to machines that perform general functions (e.g., harvesting and threshing machinery; mowing machinery; plowing, planting and fertilizing machinery; other agricultural and garden machinery; excavating machinery; loaders; wood processing machinery, such as wood chippers and debarkers; sawing machinery, including chain saws; powered conveyors; and mobile equipment, including forklifts). |
| HO 3: Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines: trencher or earthmoving equipment; fork lift; potato combine; power-driven circular, band, or chain saw | | X | See comments above pertaining to agricultural HO 2. |
| HO 4: Working on a farm in a yard, pen, or stall occupied by a (1) Bull, boar, or stud horse maintained for breeding purposes or (2) sow with suckling pigs, or cow with newborn calf (with umbilical cord present) | X | | |
| HO 5: Felling, bucking, skidding, loading or unloading timber with butt diameter of more than 6 Inches. | | X | Remove 6-inch diameter threshold. |
| HO 6: Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc) at a height of more than 20 feet | | X | (1) Expand to include work on roofs, farm structures including silos, grain bins, windmills, and towers, and vehicles, machines, and implements and (2) reduce the maximum height at which youths may work in these settings from 20 feet to 6 feet. |
| HO 7: Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a | | X | (1) Expand to prohibit driving of all motor vehicles and off-road vehicles (including all-terrain vehicles), with or without passengers, |

**Table 4-5. Summary of NIOSH Recommendations Pertaining to Existing Agricultural Occupation HOs, 2002**

| Existing Agricultural HO | Retain | Revise | Specific Recommendations |
|---|---|---|---|
| passenger or helper | | | on or off the highway; (2) expand to prohibit work as an outside helper on a motor vehicle; (3) retain the provision prohibiting riding on a tractor as a passenger or helper, but move it under Agricultural HO 1. |
| HO 8: Working inside a fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere; an upright silo within 2 weeks after silage has been added or when a top unloading device is in operating position; a manure pit; a horizontal silo while operating a tractor for packing purposes | | X | Expand to prohibit *all* work inside (1) a fruit, forage, or grain storage, such as a silo or bin; (2) a manure pit. |
| HO 9: Handling or applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) Agricultural Chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act (as amended by Federal Environmental Pesticide Control Act of 1972, 7 U.S.C. 136 et seq.) as Toxicity Category I, identified by the word ADanger@ and/or APoison@ with Skull and Crossbones; or Toxicity Category II, identified by the Word AWarning@ on the Label | | X | Expand to be consistent with EPA Worker Protection Standard for pesticides, encompassing prohibitions against pesticides with chronic health effects as well as pesticides with recognized acute toxicity. |
| HO10: Handling or using a blasting, including but not limited to dynamite, black powder, sensitized ammonium nitrate, blasting caps, and primer cord | X | | |
| HO 11: Transporting, transferring, or applying anhydrous ammonia | X | | |

## Extramural Childhood Agricultural Injury Prevention Programs and Partnerships

### National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS)

The $3.75 million dedicated annually for extramural funds is primarily for R01 research grants and to fund a national children's agriculture injury prevention center. Currently, NCCRAHS, located within the National Farm Medicine Center in Marshfield, Wisconsin, receives the center portion of these funds. NCCRAHS strives to enhance the health and safety of all children exposed to hazards associated with agricultural

work and rural environments. In addition to the AFF Program, NCCRAHS also receives funding from the Maternal and Child Health Bureau (MCHB). The dual sources of funding allow the Center to provide a wide range of services related to children and adolescents living in rural areas and working in agricultural environments. (Appendix 4.1-09)

A major activity undertaken by NCCRAHS has been developing the NAGCAT [North American Guidelines for Children's Agricultural Tasks 1999]; guidelines to help parents assign farm jobs to their children aged 7 to 16. NAGCAT allows children and adolescents to gain meaningful work experience, but with a reduced risk of agricultural-related injury. These recommendations were developed via a panel of agricultural safety and health and child development experts, including a representative of the AFF Program. Widely cited by both the professional and public press, the NAGCAT has been found effective in reducing youth farm injuries in one controlled study in which farm parents who used the NAGCAT reported a 50% reduction in youth farm injuries compared to youths in control farm families [Gadomski et al. 2006].

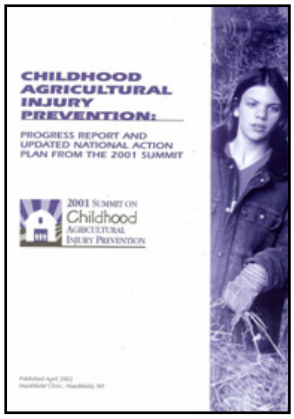
Surveillance from the AFF Program has identified that more than half of all injuries and fatalities occurring to youths on farms are not work-related [Adekoya 2001]. In response, NCCRAHS has initiated a safe play area initiative for farms to reduce youth exposures to farm hazards. The Center published *Creating Safe Play Areas on Farms* in 2003 to provide safety professionals and community leaders' guidance on addressing this emerging issue [Esser et al. 2003]. This document has increased attention to the development of safe, structured, supervised play areas for children on farms, and has prompted many Safety Day Camps for farm youths to offer parent-oriented programs to promote fenced, supervised play areas for children on farms.


A third major undertaking by NCCRAHS was sponsoring a third national childhood agricultural injury conference in 2001. The conference was designed to assess progress in meeting the goals of the original NCCAIP action plan and to update the plan as needed. Funding for the conference was provided by the AFF Program with funds initiated by Senator Herb Kohl (D-WI). AFF Program staff helped plan the conference and participated on special emphasis panels. Results of this conference were released in 2002 [Esser et al. 2003]. Additional NCCRAHS activities are listed on the Web site at: http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nccrahs_welcome).

**Grants**

Other extramural funds from the Childhood Agricultural Injury Prevention Initiative have been used to fund 32 R01 grants since 1997. Topics addressed in the studies include occupational injury in Hispanic farm worker families, risk factors for injury among migrant and seasonal farm worker children, effects of work permits in

protecting youth workers, pesticide training for adolescent migrant farm workers, and effectiveness of farm safety day camps for children. At annual meetings with R01 grant recipients, the Program shared results from its ongoing childhood agricultural injury surveillance activities.




**Conferences**

In 1998, the AFF Program, in conjunction with Purdue University, sponsored a workshop entitled "The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective." Forty-three representatives from such industrial areas as agricultural chemical manufacturers, insurance companies, and safety equipment manufacturers identified budget constraints and a perceived lack of benefits to organizations as primary reasons the private sector might reject requests for support by groups such as NCCAIP. They believed the problem was a community one requiring a broad-based collaborative effort and that additional regulation was not needed. Purdue University produced a final report summarizing the workshop that has been made available through the National Technical Information Service [National Technical Information Service 1999].

In addition to this workshop, the AFF Program has organized several special sessions on the topic of childhood agricultural injuries at various conferences. Five such conferences follow:

- Fourth International Symposium: Rural Health and Safety in a Changing World, October 18–22, 1998, Saskatoon, Saskatchewan, Canada.
- Agricultural Safety and Health in a New Century, April 28–30, 2000, Cooperstown, New York.
- National Occupational Injury Research Symposium, October 17–19, 2000, Pittsburgh, Pennsylvania.
- National Institute for Farm Safety 2001 Annual Meeting, June 24–27, 2001, Pittsburgh, Pennsylvania.
- National Injury Prevention and Control Conference, May 9–11, 2005, Denver, Colorado. On September 22, 1999, NIOSH conducted a midcourse review of the Childhood Agricultural Injury Prevention Initiative. No one disagreed with the course the AFF Program had taken with the Childhood Agricultural Injury Prevention Initiative and all believed funding should be continued.

Finally, the AFF Program formed a Federal Interagency Working Group on Preventing Childhood Agricultural Injuries in 2001. Currently, 11 Federal agencies with an interest, mission, or mandate in childhood agricultural injury prevention sit on this working group (Table 4-6). The purpose of the working group is to share information about activities within the various agencies that relate to childhood agricultural injuries, and to promote the inclusion of childhood agricultural injuries in any new activities. Bi-annual meetings have been held to date.

**Interactions with Extramural Partners**

The AFF Program has been working with our extramural partners from the beginning of the childhood agricultural injury prevention movement in the early 1990s (Appendix 4.1-09). Activities arising from these relationships include the following:

**Table 4-6. Federal agencies participating in the NIOSH Federal Interagency Working Group on Preventing Childhood Agricultural Injuries during 2006.**

| Participating Federal Agencies |
|---|
| Consumer Product Safety Commission |
| HRSA, Maternal Child Health Bureau |
| US Department of Education, National FFA Advisor |
| National Center for Injury Prevention and Control |
| USDA, NASS |
| US Department of Education, Office of Migrant Education |
| DOL, Occupational Safety and Health Administration |
| CDC, Division of Community and Migrant Health Centers |
| National Institute of Child Health and Human Development |
| USDA, Cooperative State Research, Education, and Extension Service |
| DOL, Employment Standards Administration |
| DOL, Employment and Training Administration |
| Indian Health Service |

An AFF Program researcher was an invited member of the Agricultural Engineering/Structural/ Environmental working group of the 1992 Childhood Agricultural Injury Prevention Symposium. He helped to identify major injury issues and propose recommendations develop working relationships with representatives of agricultural equipment manufacturers and professional societies.

In 1999, an extramural AFF Program researcher at the National Farm Medicine Center sought assistance from intramural AFF Program researchers on a research project requiring a national sample of farms with household youths aged 7–16. The AFF Program worked with NASS to identify farms with household youths in this age range and enlist their participation as part of the CAIS data collection effort. The extramural researcher was given access to those farm families who agreed to participate. Results of her study are reported in the following publication:

Marlenga BL**,** Pickett W, Berg RL [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. Preventive Medicine *35*:150–159. PubMed ID: 12200100 (ISI Web of Science: Cited 7 times as of 11/17/06)

The AFF Program has also worked with NASS to provide CAIS data to Dr. Marlenga for two additional research studies. She used results from the 1998 CAIS to assess whether guidelines for assigning youths work tasks based on their age would have prevented certain types of farm injuries. Results of this research are reported in the following publication:

Marlenga BL**,** Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. Injury Prevention *10*:350–357. PubMed ID: 15583256 15583256 (ISI Web of Science: Cited 3 times as of 11/17/06)

Data from the 1998 CAIS and 2000 M-CAIS have also been provided to Dr. Marlenga to assess the potential impact of applying Child Labor HOs for youths working on farms to youths working on their family's farm. This research is still in progress.

### 4.1c Selected Outputs

Results from the Initiative have been disseminated at scientific conferences and professional meetings, through journal articles and NIOSH documents, such as statistical abstracts and informational/educational pamphlets. A search of the literature has identified a minimum of 22 peer-reviewed journal articles that have cited surveillance data from the CAIS.

**Recommendations Regarding Child Labor**

The AFF Program provided testimony to ESA on changes to child labor regulations in 1994. These comments formed the basis for the AFF Program's later work on a scientific-based assessment of existing child labor rules and recommendations of change submitted to ESA under an interagency agreement in 2002.

AFF Program staff used data from the 1998 CAIS to recommend changes to the agricultural HOs for the DOL. The 1998 CAIS provided the most representative and current data on occupational youth farm injuries by covering youths of all ages and farms of all types.

The lead author of the AFF Program's HOs report was invited to participate in a 2002 meeting on the development of guidelines for defining hazardous child labor, hosted by the International Labour Organization (ILO) in Geneva, Switzerland. Nations that had ratified ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour) had requested assistance in meeting a requirement to identify hazardous child labor within 2 years of ratifying the convention. The author provided a copy of the AFF Program recommendations on HOs as an example of an approach that other nations could use to identify hazardous work for youths.

**Nonwork Injuries and Fatalities on Farms**

One significant finding from the CAIS, M-CAIS, and AFF Program death certificate studies has been the importance of nonwork injuries and fatalities to youths on farms. These findings led to developing a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address nonwork injuries on farms [Esser et al. 2003]. In response to this new recommendation, the NCCRAHS produced several documents on the importance and design of safe play

areas for children on farms. NCCRAHS also maintains a Web site dedicated to the topic of safe play areas on farms (http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_nccrahs_safe_play_welcome).

**Musculoskeletal Disorders**

Published papers on chronic musculoskeletal disorders have served as the basis for subsequent grants and development of follow-on research proposals. Findings have also provided the impetus for funding research on preventing MSDs for youths working in agriculture. This series of studies has increased public awareness of the potential risks for youths working on farms. Results of the studies identified those tasks typically performed by youths on farms that posed a high risk of chronic low back pain and highlighted the barriers to the public adopting the recommendations. Current projects are aimed at identifying and evaluating simple solutions for many of the high risk jobs.

**Prominent Outputs**

A publication that identified motor vehicles and intentional causes of death to be major issues for youths living on farms [Goldcamp, et al], "Farm fatalities to youth 1995–2000: a comparison by age groups." This article was published in the *Journal of Safety Research* in 2004 [Goldcamp et al 2004].

This conference report influenced AFF Program research directions and those of other organizations after its release in 2002: *Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit* [Lee et al. 2002].

This 1996 report was the basis for the NIOSH Childhood Agricultural Injury Prevention Initiative: *Children and Agriculture: Opportunities for Safety and Health* [NCCAIP 1996].

**Data Bases**

The CAIS (data available for 1998, 2001, and 2004) is the key surveillance activity to track youth farm injuries over time. This is the primary data source used to define outcomes for the NIOSH Childhood Agricultural Injury Initiative. A similar database on minority youths is the M-CAIS (data available for 2000 and 2003).

**Conferences**

One of the more important conferences assessed how well the AFF Program was conducting the Childhood Agricultural Injury Prevention Initiative. The *2001 Summit on Childhood Agricultural Injury Prevention* was held in 2001 in Minnesota. It provided guidance on the types of issues the initiative should be addressing.

**A complete list of outputs can be found in section 4.5 at the end of this chapter.**

### 4.1d Intermediate Outcomes

**Surveillance**

AFF Program surveillance activities have influenced the types of outreach and research being done on childhood agricultural injury prevention while also providing vital information to track the changes in youth farm injuries over time. Intermediate outcomes related to the surveillance program follow:

NCCRAHS is just one of the national child safety organizations that use the results from the AFF Program youths farm injury surveillance studies. Other organizations, such as Farm Safety for Just Kids and the National Safe Kids Campaign now use the Program's injury and injury rate estimates for children on farms as their official numbers.

The estimates of youths farm injuries produced by the AFF Program have also been cited in proposed Congressional legislation. In 2005, the Children's Act for Responsible Employment (CARE) Act (HR 3482) was submitted in the House of Representatives by Representative Roybal-Allard. The CARE Act proposed changes to child labor laws in agriculture and identified the youths farm injury data collected by the AFF Program CAIS as one source of data that would be used to develop an annual report on occupational injuries to youths working on farms in the United States. At this time, no action has yet been taken on this proposed bill within Congress.

**Child Labor Hazardous Orders**

The AFF Program has been a leader in promoting science-based recommendations on improving the current Child Labor HOs as they apply to young agricultural workers. Intermediate outcomes from these efforts follow:

As part of a cost-benefit analysis of proposed changes to Child Labor HOs for youths working on farms, a contractor for DOL requested data from the AFF Program in 2004. The contractor, SiloSmashers, asked for information about estimates of youths under age 20 working on farms, estimates of working youths who operated farm tractors on farms, work-related injuries occurring to these youths, and nonwork injuries occurring to youths on farms. SiloSmashers concluded that the AFF Program CAIS surveillance data were the only source of these data, and were critical to conducting the cost-benefit analysis requested by DOL. This work is still in progress.

In response to the AFF Program-sponsored report, *Protecting Youths at Work*, developed by the National Research Council and Institute of Medicine, the DOL, ESA established an interagency agreement with NIOSH to develop recommendations for changes to Child Labor HOs.

Responding to the release of the AFF Program HOs recommendations, DOL, ESA convened a series of stakeholder meetings to gather input on priorities for future rulemaking. Several organizations with interests in youths work in agriculture were represented at a meeting attended by authors of the AFF Program report, including the Farmworker Justice Fund, the National Consumers League, the USDA, the Pennsylvania State University, and the Tennessee Agricultural Extension Service.

In March 2003, the Young Worker Health and Safety Network (YWH&S) released its report, NIOSH Recommendations for Changes to the Federal Child Labor Regulations: A Response from Members of the Young Worker Health and Safety Network. The network is a subcommittee of the Occupational Health and Safety section of the American Public Health Association, composed of public health professionals, advocates, educators, and government agency staff. More than 25 persons from a variety of disciplines, including representatives of NIOSH, collaborated to develop the network's response to the NIOSH HOs recommendations [Young Worker Health & Safety Network 2003]. The YWH&S Network agreed with all NIOSH recommendations pertaining to the existing HOs for agriculture, and flagged four agricultural HOs as top priorities for regulatory action.

The YWH&S Network comments were also the topic of a peer-review journal article, which further encouraged implementation of the NIOSH recommendations by DOL, ESA [Miller, Bush 2004].

In 2003, the Farmworker Justice Fund called for DOL to revise the HOs for youths in agricultural occupations, citing the AFF Program's recommendations as the basis for these revisions [Farmworker Justice Fund, Inc. 2003].

In 2005, the Child Labor Coalition (CLC) prepared a report entitled *Protecting Working Children in the United States: Is the Government's Indifference to the Safety and Health of Working Children Violating an International Treaty?* [Child Labor Coalition 2005]. The CLC is a group of nongovernmental organizations whose mission is to end child labor exploitation in the United States and abroad and to protect the health, education, and safety of working minors. The CLC report was submitted in June 2005 to the ILO Committee of Experts, an independent body charged with examining the application of ILO conventions in member States. In the report, the CLC questions whether the United States is in compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour), with particular emphasis on HOs and children working in agriculture. Several pages of the report are devoted to a discussion of needed revisions to agricultural HOs, with data and rationale from the AFF Program HOs report used as the primary justification for changes. The report urges ESA to take action on AFF Program recommendations, particularly those which focus on the agricultural HOs.

At the 2006 annual meeting of the ILO in Geneva, Switzerland, the Conference Committee on the Application of Standards discussed the U.S. application of Convention No. 182 as it relates to children performing hazardous work in

agriculture. The Committee of Experts report used as a resource by the ILO Conference Committee mentions the AFF Program recommendations on HOs, noting that the U.S. Government has indicated that it is "in the process of determining which recommendations concerning the Hazardous Orders will be presented in a first round of proposed rules" [International Labour Organization 2006]. The Conference Committee requested that the U.S. Government provide copies of any new HOs when adopted. In addition, the Conference Committee requested the U.S. Government to "indicate, in its next report to the Committee of Experts, the measures taken or envisaged (including but not limited to legislation) to ensure that work performed in particular in the agricultural sector was prohibited for children under 18 years where it was hazardous work within the meaning of the Convention" [International Labour Organization 2006].

The CLC followed the action by the ILO Conference Committee with a letter to Secretary of Labor Elaine Chao requesting that forthcoming proposed changes to child labor laws focus on agriculture. The letter references the 2002 NIOSH report recommending changes to HOs, and the discussions at the 2006 annual ILO meeting questioning United States compliance with ILO Convention No. 182 in relation to children working in agriculture:

The Child Labor Coalition strongly urges the Labor Department to make agricultural HOs a top priority within the anticipated child labor regulatory action in 2006. Given that the lead advocacy group (CLC) and the lead group of health and safety experts on child labor (YWH&S Network); and the government's lead agency on occupational safety and health (NIOSH) recognize the pressing need to strengthen the agricultural HOs, it would be deplorable if the 2006 proposed child labor regulations do not include agriculture in the scope of proposed rulemaking. Furthermore, in light of increased attention by the ILO on the issue of children in hazardous agricultural employment and their request for more information related to measures taken or envisaged, it would certainly not be overlooked if the DOL's regulatory changes in child labor exclude or minimize agriculture [Child Labor Coalition 2006].

In 2003 and again in 2005, Representative Tom Lantos (D-California) introduced the Youth Worker Protection Act, which would amend the FLSA of 1938 to revise requirements relating to child labor and to set forth new requirements for the employment of minors. The Act included a provision directing the Secretary of Labor to promulgate a rule relating to particularly hazardous occupations for children between the ages of 16 and 18, specifying that this rulemaking was justified based on the HOs recommendations released by the NIOSH in 2002 [GovTrack.us 2006a,b].

### 4.1e End Outcomes

During AFF Program activity, the total number of youths injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number of farm work-related youths injuries decreased by 51% from 16,695 to 8,130 (Table 4-1) [NIOSH CAIS]. Injury rates for household youths show that farm injury risks have decreased in all regions of the United States (Figure 4-3) [NIOSH CAIS].

Work-related farm injuries to youths living on the farms have decreased from 11,600 injuries in 1998 to 6,400 in 2004. The work-related injury rate for household youths decreased from 14.1 to 9.1 injuries per 1,000 working household youths for the same period (Figure 4-7) [NIOSH CAIS].

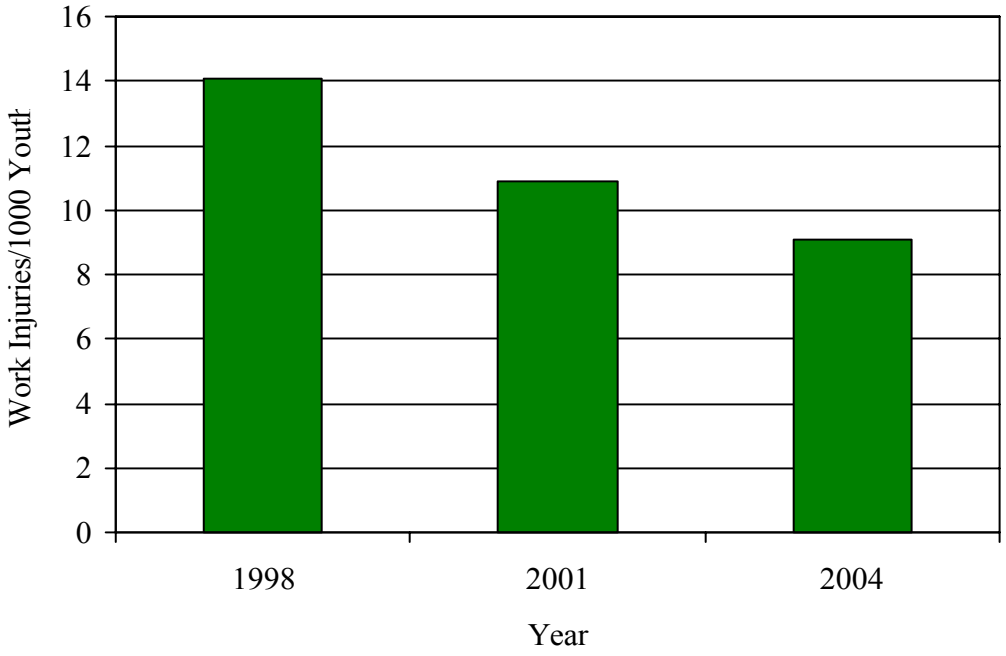



**Figure 4-7:** Work injuries per 1,000 household youths, 1998–2004. *Source: NIOSH CAIS.*

Males account for 58% of the household youths who work on farms, and have traditionally accounted for most of the work-related youths injuries occurring on farms. Farm injuries to young males on farms decreased 50%. A major part of this decrease was seen for work-related farm injuries to males that decreased from 11,800 in 1998 to 5,000 in 2004 [NIOSH CAIS]. The AFF Program feels it has made a contribution to this reduction in work-related farm injuries to youth.

### 4.1f External Factors

Even though research has indicated that education of farm workers, farm families, and youths on farms is needed to address the problem of youths injuries on farms, current child labor laws do not allow for regulatory options for youths on family farms. Therefore, education and engineering controls appear to be the only options for continuing the observed decrease in youths farm injuries.

Yet education and engineering controls are also subject to forces beyond our control. For example, education efforts can be hampered when effective surveillance methods are either unavailable or disrupted. The AFF Program is working with NCCRAHS and other external partners to better address prevention approaches for migrant and seasonal workers, an area NIOSH has not traditionally addressed. In the spring of

2005, DOL decided to discontinue NAWS. After receiving many comments from farm worker advocacy groups and Federal agencies (including NIOSH), DOL decided to retain NAWS, but not as an ongoing annual survey. DOL has not yet determined how often NAWS will be conducted, or what the sample size will be when data are collected. The AFF Program is continuing to work with DOL at this time; however, other options for collecting information for seasonal and migrant workers may be needed.

The lack of a systematic surveillance system for tracking nontraumatic MSDs (e.g., back, shoulder, and hand/arm disorders) for youths working in agriculture has made it difficult to determine the effectiveness of AFF Program efforts in this area. Without adequate surveillance data, it is not possible to obtain a true assessment of the current magnitude of the health problem, or to determine the effectiveness of any targeted interventions the AFF Program may propose. The AFF Program will continue to pursue novel surveillance methods to remove these barriers.

Changes in national leadership have also affected our work. The scope of the AFF Program recommendations on changes to HOs was delineated in interagency agreements between NIOSH and ESA in fiscal years 1999, 2000, and 2001. However, as the AFF Program report neared completion, the change in Administration in 2001 led to changes in leadership at DOL and ESA. The new leadership had no investment in the AFF Program report. In general, regulatory actions by DOL agencies have become increasingly difficult to initiate, as Federal agencies wishing to propose new rules are now required to evaluate the economic impact of these proposals. It is possible that the increased complexity of the rulemaking process has contributed to inaction by ESA on the HOs for agricultural occupations.

### 4.1g Future Directions

The AFF Program, through its Childhood Agricultural Injury Prevention Initiative, will continue to provide leadership in childhood agricultural injury prevention and surveillance, and will seek to address the recommendations in the National Action Plan and the 2001 Summit report. Plans are being developed for a public meeting and symposium to assess the progress and new emphasis areas for the initiative in fiscal year 2008.

Ongoing internal surveillance activities will be continued on a 3- to 5-year cycle. The AFF Program will continue its partnership with USDA, NASS. The CAIS and M-CAIS have proven to be valuable methods of data collection. In addition to filling a critical data need, the collection on nonwork farm injuries has proven to be informative. The ongoing nature of these two surveys will allow for tracking youths farm injury data over time, and the fact that some aspects of the surveys are dynamic and can be altered allows for incorporating lessons learned. Previously collected data has led to many interesting findings, including an increase in female youths farm injuries.

In the past year, the AFF Program has worked with USDA, NASS to conduct a survey of hazards on U.S. farms. Hazard surveillance systems offer several ways to improve safety and health: by identifying and quantifying exposures associated with many agricultural hazards, such as tractors without ROPS; targeting high-risk groups for intervention; evaluating the effects of engineering technologies; anticipating injury and illness; and disseminating important safety and health information to agricultural workers and farm families. After the completion of the current effort, the AFF Program will assess whether this approach should be repeated on a periodic basis similar to the CAIS and M-CAIS.

The AFF Program will continue to analyze data collected through the CPSC NEISS in the future. Current plans are to assess farm youths cases in NEISS every 3 to 4 years, depending on the number of cases available from the surveillance system.

The potential funding problems for the NAWS are a concern. If NAWS is not funded, the AFF Program will explore other options for collecting injury data on migrant and seasonal workers.

Research has shown that nonwork-related agricultural injuries remain a problem for youths on farms. The AFF Program has begun to examine some of the causes for these injuries, and will seek out additional external partners with experience in nonoccupational injuries to help address this problem.

A gap is the lack of a national surveillance program to track cases of chronic work-related MSDs in youths working in agriculture. Focus group participants, including both farm parents and farm youths, indicated that MSDs could be a problem, but no systematic collection of this type of data exists. Moreover, it is diffcult to determine the potential long-range impact of heavy physical work on farmworkers who grow up performing it from an early age. The AFF Program will continue to explore novel surveillance methods to improve the effectiveness of this MSD research program. Efforts are currently underway to develop training programs for youths that focus on identifying tasks with high risk of MSDs and ways to reduce the risk by using ergonomic principles and interventions.

### 4.1h List of NIOSH projects included in this section

- DSR-9278807-Fatality Assessment and Control Evaluation (FACE) Project (Appendix 3.3-01)
- DSR-9278870-State-Based Fatality Surveillance Using Face Model (Appendix 3.3-02)
- DSR-9278953-Childhood Agricultural Injury Surveillance (Appendix 4.1-01)
- DSR-VLE8866-Emerging Problems in Occupational Injury Epidemiology (Appendix 4.1-02)
- DSR-VLE8941-Injury Risk Factors in Migrant and Seasonal Workers (Appendix 4.1-03)

- DART-9277047-Workplace Hazards to Children and Adolescents in Agricultural Work Settings (Appendix 4.1-04)
- DART-927006E-Ergonomic Interventions for Youth Working in Agriculture (Appendix 4.1-05)
- DSR-9277187-Young Worker Health and Safety (Appendix 4.1-06)
- DSR-VLB8806-Surveillance of Occupational Injuries Among Children and Adolescents (Appendix 4.1-07)
- DSR-9278847-Emerging Issues in Injury Surveillance (Appendix 4.1-08)
- DSR-9278954-Childhood Agricultural Injury Prevention (Appendix 4.1-09)

## 4.2 Minority Populations

**4.2 Goal:** Reduce injuries, illnesses, and fatalities among migrant and minority farm workers.

### 4.2a Challenge or Issue

Health disparities by race and ethnicity have long been recognized in the U.S., but the field of occupational health has only recently given these issues attention [Frumken and Pransky, 1999]. There are numerous studies showing that agricultural workers in general are often exposed to hazards that cause injury or ill health [Kirkhorn and Schenker, 2002, Merchant et al.,1989], including: chemicals that may have long or short-term health affects [Beaumont, 1995] plants that may cause allergic reactions [Ballard 1995], heavy and/or awkward tasks that take their toll on the body's musculoskeletal system [Schenker, 1996; Villarego, 1999], livestock and machinery that may cause debilitating injuries including noise induced hearing loss [(McBride et al., 2003; Crutchfield and Sparks, 1991]and injuries or illness resulting from exposure to the elements [Arcury et al., 2002; Mobed et al.,1992;Calderon et al., 1993]. Restriction in access to health services, unfamiliarity with workplace health concerns, regulations, and disproportionate assignment to unsafe jobs may increase the risk of work-related illness or injury for minority workers [Frumken and Pransky, 1999]. Census data have shown that minority workers on average often have less education, lower income levels, and inferior housing. Cultural factors also exist that may put farm workers and farm operators at risk. Conceptions of health and disease among minority workers may also differ and lead to under-reporting of conditions.

Different farm worker groups have different problems. Little attention has been paid to Native American workers by the agricultural safety and health community. A review of death certificates in New Mexico documented a much higher than expected work fatality rate for Navajo engaged in agriculture. The people of the Navajo Nation, located in northwestern New Mexico and northeastern Arizona, have a history of sheep-herding and subsistence farming for their livelihood. In recent years, seeking to improve their economic position, they have transitioned to cattle raising. Limited experience working with the larger, more dangerous animals, created serious injury risk situations.

Orchard workers are exposed to a variety of hazards that contribute to injury, disability, and death. Their work life and work activities vary by season and by the specific needs of the growers. Although picking fruit is often viewed as the primary role of the orchard workers, they are involved in a multitude of other tasks over the farming seasons. All of these activities are accompanied by hazards that may result in injuries and illnesses. Examples of commonly reported events are back injuries, eye injuries, sprains and strains, amputations, fractures, cuts, lacerations, burns and electrocutions, and poisonings (from chemicals and pesticides). Traumatic occurrences were related to improper operation of machinery as well as to livestock, ladders, and electricity. In addition to multiple physical hazards, orchard workers are often exposed to working conditions that increase their susceptibility to injury. For example, they may be required to work long hours under severe time constraints and their work may be hampered by weather conditions.

### 4.2b Activities

The AFF Program focus on minority workers in agriculture has lead to two distinct surveys of agricultural workers facing a variety of risk factors that impact occupational health: hired farm workers and farm operators (managers).

**Hired Farmworkers**

In 1995, NIOSH convened an expert panel on hired farm worker occupational health and safety. The panel issued an official report in 1998 that recommended new directions for surveillance of farm worker occupational health and safety. Priority areas identified in this report are musculoskeletal disorders, pesticide-related conditions, traumatic injuries, respiratory conditions, dermatitis, infectious diseases, cancer, eye conditions, and mental health. Using these recommendations as a starting point, NIOSH convened a two day working meeting in 1998 to develop the questions for the October 1998 - September 1999 Health Supplement to the National Agricultural Workers Survey (NAWS). Researchers from community organizations and research agencies with expertise in farm worker health attended the meeting. They represented academic institutions, industry, migrant advocacy groups, agricultural extension services, and government agencies, including the Department of Labor (DOL), Environmental Protection Agency (EPA), Food and Drug Administration (FDA), National Cancer Institute (NCI), Health Research and Services Administration (HRSA), and Occupational Safety and Health Administration (OSHA). (Appendix 3.2-03)

A draft questionnaire was developed in collaboration with external partners. It was translated into Spanish, and pilot tested in 1998 with farm workers in several regions of the country. Following the pilot testing, a meeting was held with AFF Program researchers and NAWS field staff to review the pilot test results and revise the questionnaire. A second set of pilot tests and final revisions followed. Once the questionnaire was finalized, a two day training session was held with the core field interviewer staff. Following the first NAWS cycle of 1999, modest alterations were made based upon input from the field interviewers. The Supplement's main purpose

was to obtain national prevalence estimates for variables related to the occupational health of farm workers. Topics covered in the occupational health supplement included: pesticide safety training; pesticide handling and personal protective equipment; field sanitation; musculoskeletal pain/discomfort; skin conditions; respiratory symptoms; gastrointestinal illnesses; physician diagnosed health conditions; cigarette and alcohol use and quality of, and access to health care. The full supplement was administered in 1999, and some questions continued to be included in later years.

The survey found that hired farm workers and migrant workers are likely to be younger due to the strenuous physical demands of farm work. Low English literacy may have implications for health due to inability to read and understand warning signs, instructions, educational pamphlets, and other safety materials. In addition, because many farm workers are new to the United States, they may be unaware of laws that are in place to protect their health. They also may be unaware of health hazards. Due to their migratory lifestyle, many farm workers also experience a loss of social support, which is exacerbated by the fact that many also leave spouses and children behind. In addition, moving for work may also mean that a worker is unfamiliar with services available in the place they are working, which may result in an inability or hesitance in seeking preventative or necessary health care. Lack of legal status may affect farm workers' access to health care services, as well as seeking of medical care. Pesticide exposure may be increased due to housing proximity to fields and contamination of work clothes from the fields. Many of the hired farm workers are Latino, and a large number are also immigrants. They may be victims of various types of discrimination and subject to employment or other schemes. In contrast to the hired farm workers, farm operators or managers are frequently citizens, owners of their farms, older, and have higher socioeconomic status.

Data analyses, presentations and publications from this survey effort have been ongoing. A second phase of data collection with a focus on mental health, psychosocial factors and work organization has been underway. A national meeting of experts was held and a survey instrument was developed and translated. The questions underwent cognitive testing and piloting in FY06. The future of this survey is unknown and depends on external factors noted below.

**Farm Operators**

The farm operator survey was developed in collaboration with USDA and other AFF Program investigators [USDA/NASS 2002]. The opportunity to add survey questions developed with short notice as investigators needed to follow the timeline of a survey ready to be administered in the field. Investigators conducted reviews of the literature, and other national health surveys, as well as the NIOSH Farm Family and Health study, and contacted experts in the field of agricultural safety and health. (Appendix 4.2-01)

The USDA conducted the Minority Farm Operator Occupational Health Survey on behalf of the AFF Program in 2000. A stratified simple random sample of farm operators from all States was selected for interview. Hispanic/Latino, minority, and female farm operators were over-sampled. Because of a low response rate, an additional sample of Latino farm operators from California, Arizona, New Mexico, and Texas were selected for face-to-face interview to further increase the sample size. AFF Program investigators provided training for interview supervisors, and observed some of the piloting of the interviews. The response rate was 53%. Of the 7,137 respondents for whom data was available for analysis, 5,697 (80%) were farm operators, and 1,440 (20%) were farm operators' spouses (proxies), with 88% interviewed by telephone, and 12% interviewed in person. Data analyses conducted thus far include calculations of estimated prevalence of general health conditions, hearing loss, access to medical care, and mental health symptoms.

Both the Occupational Health Supplement to the NAWS and the Minority Farm Operator Occupational Health Survey were conducted in collaboration with the Office of Policy Analysis at DOL, the Health Resources and Services Administration (HRSA), and the National Agricultural Statistics Service (NASS) at USDA. Other organizations that have been consulted are *agricultural organizations* such as the National Center for Farmworker Health, Migrant Health Clinics, and the New York Center for Agricultural Safety and Health. *University academic departments* have also been collaborators, including Wake Forest School of Medicine, University of Toronto, and the University of California Davis. *Research organizations* such as Aguirre International (now called JBS International) have also collaborated with us.

One of the program's extramural components has done activities to define the epidemiology of migrant injury on a regional basis. A focus group study in 1996 led to a decision to base future surveillance upon medical records rather than interview data. A 2002 study, Estimation of New York State Migrant and Seasonal Farmworkers enabled comparison of the results to the enumeration performed by DOL. It showed substantial differences, suggesting an undercount by the DOL methodology of nearly 50 percent of the total workers in some areas.

**Activities Related to the Navajo**

Extramural AFF Program researchers enlisted the participation of the Cooperative Extension Service (CES) assigned to the Navajo Nation to address Navajo safety and health needs. With stakeholder input, we developed training modules on cattle handling safety, animal flight zone and appropriate use of chutes and gates to manage the animals. The module included a video, "Cattle Handling Safety" developed by the research team. The program was offered at least once in each of the 30 Chapter House areas. Chapter Houses are Navajo geographic designations for working cooperatives. Even the cooperatives did not have the financial means to purchase the cattle chutes and gates for proper cattle handling. As a pilot, arrangements were made for the project to purchase one set of equipment to be loaned within and among the Chapter Houses. The Chapter House was responsible for managing the loan program in an equitable fashion, while the CES assumed responsibility for equipment maintenance

and repair. The ability to borrow the equipment was contingent upon participating in the cattle safety training program.

Building on this preliminary work, we took a more structured approach to designing and evaluating the effectiveness of stakeholder-selected interventions. Using historical land ownership records, Navajo farmers/ranchers were identified and recruited to participate in a needs assessment survey conducted in Navajo (an oral, "non-written" language). The data were then used with a group of stakeholders, recruited by Chapter House leaders and the trusted CES agent, as they were guided to select three intervention priority areas and develop a logic model for the intervention to address each priority. This process was a significant capacity-building effort. In response to continued concerns about working with cattle, the Navajo requested to have the video available in Navajo, and dubbing was accomplished. Multiple copies have been made and widely distributed to Navajo CES and Chapter Houses. Another area of concern is that children are especially susceptible to drowning during flash flooding. An educational video in the Navajo language, called "Ditch Witches," has been acquired and distributed throughout the Navajo Nation.

**Activities Related to Orchard Workers**

Extramural AFF Program researchers engaged the Hispanic farm worker community through two community based participatory research projects in Washington and Idaho. They established the Northwest Community Health Worker Network and Listserv. They also trained clinicians in the diagnosis, treatment, and prevention of pesticide poisonings through training of community health workers and professional education.

Another group of extramural AFF Program researchers conducted an observational study in orchards in 1999. It recognized ergonomic problems and led to a series of orchard ergonomic intervention efforts. A pilot ergonomic study in 2001 resulted in modifications to orchard baskets aimed at displacing some of the weight of the basket from the shoulders to the hips. This change appeared to be successful. Interviews with workers involved in the trial indicated that well over 80 percent preferred the new design. The trials did point out several problems with the design that are currently being pursued.

### 4.2c Selected Outputs

One NIOSH document is in progress from the Hired Farmworkers survey effort: Occupational Health of Hired Farmworkers in the United States, National Agricultural Workers Survey Occupational Health Supplement, 1999 (undergoing review). It summarizes results from the survey. It will be sent to key migrant researchers, agricultural health centers, and made available on the NIOSH and DOL websites. A paper for publication in the peer-reviewed literature is underway. The National Center for Farmworker Health is eager to assist in dissemination of study results. Data will be shared with migrant health clinics, HRSA, DOL, Migrant Health Promotion, and Institutes at NIH, as well as agricultural researchers and workers at

Migrant Stream forums. This surveillance activity will provide data that is seriously lacking. It may have an impact on the health of migrant farm workers (Appendix 3.2-03).

Materials for migrants and minorities have been included in the National Agricultural Safety Database (NASD) (Appendix 4.2-02). NASD is a national repository of agricultural health, safety, and injury prevention materials for the agricultural community, especially for adaptation by agricultural safety specialists. This database contains a large compendium of educational and information resources organized by topic, state, language (Español), and form (e.g., fact sheet, news release, script, video abstract, poster). Both the Spanish and English versions of the NIOSH document *Simple Solutions: Ergonomics in Agriculture* are included.

Our efforts with orchard workers resulted in 15 publications, four questionnaires, a tool for identification of depression and other mental health disorders, courses, workshops, and websites.

**A complete list of outputs can be found in section 4.5 at the end of this chapter.**

### 4.2d Intermediate Outcomes

**Testimonials of Intended Use from extramural AFF Program efforts**

After a 2006 pesticide training workshop:

“What an excellent and worthwhile class! (name omitted) began using materials and knowledge from the class during a home visit to a family in White Swan on Wednesday… I have no doubt (names omitted) will use materials in the near future. Thank you for such a fine training. We’ll be providing the message to our high risk (from pesticide exposure) asthma clients.”

“It is amazing to know that there are people as you. The training had all components to achieve a behavior change. You let us develop our skills not only in the cognitive area, but also in the psychomotor, and particularly in the affective areas. Thanks so much for letting me participate. I enjoyed it. This morning I had the opportunity to talk on my radio program about pesticides. This show was terrific; I received several calls from people who work in Skagit Valley as farmers.”

"Farmworkers are a vulnerable work force to health and safety hazards at the work site, be it the harvest fields or warehouses. They are also subjected to humiliations, wage abuses, and sexual harassment because of their educational and economical disadvantaged status. The Proyecto Bienestar research findings will be the leverage to initiate solutions to these health and safety issues." - Ricardo R. Garcia, Executive Director, Northwest Community Education Center

“One of the early accomplishments of El Proyecto Bienestar was to establish a structure for communications and decision-making that is fully inclusive and

participatory. Through this process, local Hispanic populations--frequently disenfranchised, though disproportionately exposed to occupational and environmental risks--are genuinely engaged and have a voice both in assessing the type and extent of risks and also in determining the steps to mitigate those risks." - Eric Leber, Professor, Heritage University

"For Yakima Valley Farmworkers Clinic, El Proyecto Bienestar has been a powerful example of a genuine community-based participatory research partnership. It has enriched the community particularly through the training and education opportunities it has provided to local youth who are pursuing health professions education. In this way it has operationalized our belief that in addition to the immediate issue of interest, the university's presence in the community should provide long term benefit and enrichment." -Vickie Ybarra, YVFWC, Director, Planning & Development

**External Factors**

These data were collected with the assistance of the Department of Labor. The NAWS survey was originally handled through the Office of Policy and Analysis, and in 2005 moved to the Education and Training Administration of DOL. DOL contracted with Aguirre International to conduct in-person interviews throughout the United States. JBS International recently bought Aguirre International. The Minority Farm Occupational Health Survey was conducted with the assistance of the USDA National Agricultural Statistics Service. Workers in the USDA's state offices conducted computerized telephone interviews. Both surveys were done in collaboration with the NIOSH Divisions of Safety Research, and Respiratory Diseases. Approval of OMB expires in March 2007. DOL has decided not to conduct the NAWS until new approval is granted (Appendices 3.2-03, 4.2-01).

### 4.2e Future Directions

Work will continue to disseminate data from these two surveys. The future of a mental health, psychosocial and work organization supplement to the NAWS will depend on receipt of OMB clearance and successful negotiation of an interagency agreement with DOL to conduct the survey. Data from the 2006 survey of Minority Farm Operators will be available for analyses in FY2007-2008 (Appendices 3.2-03, 4.2-01).

### 4.2f List of NIOSH projects included in this section

- DSHEFS-9277323-Minority Farm Operators (Appendix 4.2-01)
- EID-9278040- National Agriculture Safety Database (Appendix 4.2-02)
- DSHEFS-9278639-National Agricultural Workers Survey (Appendix 3.2-03)

## 4.3 Logging

**4.3 Goal**: Reduce injuries, illnesses, and fatalities among logging workers.

### 4.3a Challenge or Issue

Logging Fatalities in the United States by Region, Cause of Death, and Other Factors — 1980 through 1988

John R. Myers and David E. Fosbroke

Logging has consistently been one of the most hazardous industries in the United States. Fatality and injury statistics from as early as 1955 reported a fatality rate of 214 deaths per 100,000 workers and a nonfatal injury rate of 16 injuries per 100 full-time workers [McCormack 1963]. These statistics changed little over the next three decades. In the 1980s, the average occupational fatality rate for logging was 161 deaths per 100,000 nonmanagerial workers—a rate 23 times the prevailing occupational fatality rate for all U.S. workers at that time [Myers and Fosbroke 1994]. The nonfatal injury rate for logging in 1988 was 19.6 injuries per 100 full-time workers, which was more than twice the injury rate for all U.S. workers that year [BLS 1990].

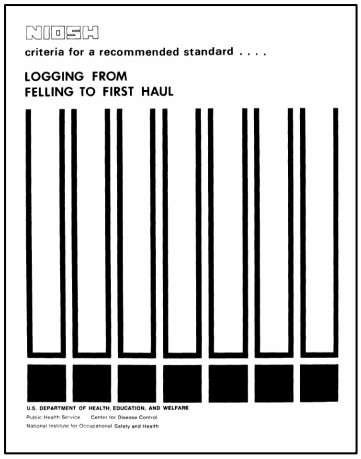
The purpose of logging is to harvest trees and transport them to a processing facility. How this is accomplished varies widely depending on where the logging is being done in the United States, the type of tree being harvested, and the harvesting techniques used. NIOSH research published in 1994 found that fatality rates differ greatly across the United States, with the highest rates found in regions using manual harvesting methods in naturally occurring forested stands where the primary product was saw timber and where no logging safety standards existed within the region [Myers and Fosbroke 1994]. In addition, the U.S. logging workforce is considered to be fairly isolated and less organized compared with other workforces [Egan 2002].

### 4.3b Activities

Given the high injury and fatality rates and the diversity of work methods within the logging industry, the AFF Program adopted a multiprong approach to address the injury problem. This approach included supporting OSHA's adoption of a national standard for the logging industry, coordinating a State-wide intervention program in Alaska to address occupational injuries and fatalities associated with helicopter logging, conducting investigations of selected logging fatalities through the FACE program, and assessing mechanical logging methods as a means for reducing injury risks.

## Development of a National Logging Standard

In 1976, NIOSH published *Criteria for a Recommended Standard: Logging from Felling to First Haul* [NIOSH 1976]. This document provided OSHA with sufficient information to formulate a national standard for the logging industry. At that time, OSHA had adopted an existing ANSI standard for pulpwood harvesting as a national consensus standard, but it did not address saw timber harvesting. No action was taken by OSHA on a logging standard that would address both pulpwood and saw timber harvesting until 1989, when the agency requested comments on a proposed rule for the entire logging industry. This new standard was based largely on the 1976 NIOSH criteria document.




Between July 31, 1989, and October 19, 1990, NIOSH provided three sets of comments to OSHA supporting the proposed logging rule. The AFF Program provided data from the NTOF surveillance system to support the standard. NIOSH also provided OSHA with recommendations about 1) including multiple safe felling techniques, 2) making changes to the snakebite section of the standard, 3) improving work area organization and communications, 4) using ROPS and FOPS, and 5) prohibiting certain unsafe harvesting techniques. Through NIOSH, the AFF Program provided follow-up comments on July 24, 1990, to emphasize the importance of worker training in safe chain saw use, to re-emphasize the importance of ROPS and seatbelts on logging equipment, and to recommend that all workers be trained in basic first-aid and cardiopulmonary resuscitation. In 1994, OSHA adopted the final standard, which incorporated the majority of the recommendations made by the program [59 Fed. Reg.[2] 51672 (1994)].

## Advancements in Helicopter Logging Safety

Because of changing environmental restrictions on road building in Alaska's national forests in the late 1980s and early 1990s, helicopters emerged as a major transportation mode for moving cut logs from logging sites. Amid the rapid growth of this new industry in Alaska, serious occupational safety and health issues quickly emerged. Between January 1, 1992, and June 30, 1993, six helicopter crashes occurred within the Alaska logging industry (Table 4-7), resulting in nine fatalities and 10 severe injuries. An even greater concern was that these six events occurred among only 25 helicopters flying in Alaska logging operations. These events led to an extraordinarily high annual crash rate of 16% and a catastrophic annual fatality rate of 5% (5,000 deaths per 100,000 pilots). NIOSH investigations revealed that all crashes involved improper operation and/or maintenance practices. (Appendix 4.3-01)

[2] *Federal Register*. See Fed Reg. in references.

**Table 4-7. Alaska logging helicopter incidents investigated by the AFF Program between January 1992 and July 1993**

| Date | No. of deaths | No. of injuries | Type of helicopter | Logging company |
|---|---|---|---|---|
| 2/23/1992 | 6 | 5 | Manufacturer A, Type A Single engine | A |
| 3/6/1992 | 0 | 2 | Manufacturer A, Type A Single engine | A |
| 11/10/1992 | 0 | 0 | Manufacturer A, Type B Single engine | A |
| 2/19/1993 | 2 | 0 | Manufacturer A, Type A Single engine | B |
| 5/2/1993 | 1 | 1 | Manufacturer A, Type C Single engine | B |
| 5/8/1993 | 0 | 2 | Manufacturer A, Type A Single engine | B |

After the occurrence of two serious logging helicopter crashes during one week in May 1993, NIOSH began a series of urgent consultations culminating in an emergency session of the Alaska Interagency Working Group for the Prevention of Occupational Injuries in early July 1993. Members of this committee included representatives from the Federal Aviation Administration, National Transportation Safety Board, U.S. Coast Guard, U.S. Forest Service, OSHA, the Alaska Department of Labor, the Alaska Department of Social Services, and NIOSH. Before this meeting, NIOSH developed a draft helicopter logging event matrix to identify risk factors contributing to these crashes (Table 4-8).

*A logging helicopter crash-Dora Bay, AK*

The prevention-matrix approach resulted in the development of new recommendations to address these factors by the Alaska Interagency Working Group (Table 4-9). By late July 1993, all helicopter logging sites and ramps in the State had been visited by the appropriate jurisdictional agencies. These inspections resulted in having a number of operations curtailed or entirely shut down for irregularities. Since the initial actions of the Alaska Working Group in 1993, only one logging helicopter crash has occurred in the State of Alaska.

**Table 4-8. Risk factors contributing to crashes during Alaska helicopter logging events***

| | Host/human | Agent/vehicle | Environment |
|---|---|---|---|
| Pre-event/ pre-injury factors | Pilot training and experience<br><br>Fatigue<br><br>Stress<br><br>Alcohol use<br><br>Ground crew training and experience | Helicopter lift and durability<br><br>Maintenance and repairs<br><br>Engines and controls<br><br>Ergonomics<br><br>Unstable work platform<br><br>Surplus/improvised equipment | Terrain<br><br>Weather<br><br>Landing zones<br><br>Oversight FAA (CFR† Part 133) of industry |
| Event/injury factors | Pilot reaction to emergency situation (i.e., autorotation)<br><br>Task overload<br><br>Ground crew reacting and avoiding | Helicopter autorotation performance<br><br>Deformation on impact<br>Fires and explosions | Terrain<br><br>Weather |
| Post-event factors | Types of injury<br><br>Severity | | Little assistance available or EMS not available |

*Based on investigations conducted by the AFF Program.
†Code of Federal Regulations. See CFR in references.

**Table 4-9. Alaska helicopter logging injury countermeasures from the Alaska Interagency Working Group for the Prevention of Occupational Injuries, July 1993**

| Risk factor | Host/human | Agent/vehicle | Environment |
|---|---|---|---|
| Pre-event/ Pre-injury | Increased training for pilots and ground crew<br><br>Improved work/rest cycles | Maintenance per manufacturer's recommendations<br><br>Impact (g)- resistant seats<br><br>NTSB - to prohibit surplus equipment | Improved interagency communication<br><br>Increased FAA oversight |
| Event/Injury | Practical training in autorotation | —— | Emergency (backup) landing zones |
| Post-event | —— | —— | —— |

## Logging Fatality Investigations

NIOSH established the FACE Program in 1982, with the primary goal to conduct detailed investigations of selected fatalities within the United States and to make clear recommendations about how such deaths can be prevented. During its 25 year history, FACE has targeted several categories of occupational fatalities, addressing such hazards as confined spaces, electrocutions, falls, and machinery (Appendices 3.3-01, 3.3-02).

In 1991, the decision was made to expand the FACE model beyond a cause-specific model to include an industry sector component. Because of its high fatality rates, the logging industry was added as a target within FACE in 1991. To identify logging–related fatalities, the AFF Program collaborated with State or Federal OSHA offices within Alaska, North Carolina, South Carolina, Virginia, and West Virginia. In addition, they collaborated with the Allegheny County Corner's Office in Pennsylvania and the State Medical Examiner within the State of West Virginia. Between 1991 and 1996, the AFF Program investigated 22 fatalities associated with logging. At that time, NIOSH decided to remove logging as a targeted area for the

FACE program. Since 1996, four additional logging-related fatalities have been investigated as part of the FACE program. Two investigations were conducted in conjunction with the West Virginia State-FACE program to provide the State investigator with training in conducting investigations of logging fatalities. The remaining two investigations examined fatalities that occurred within the logging industry and involved other FACE priority areas (Hispanic workers and Machinery deaths). Table 4-10 summarizes these investigations.

**Table 4-10. Number of AFF FACE investigations by cause and location of fatal event, 1991 through 2004.**

| Number of Investigations | Cause of fatal event | Location of fatal event |
|---|---|---|
| 15 | Falling trees/snag | Arkansas (1), North Carolina (1), Pennsylvania (2), South Carolina(3), Virginia (1), West Virginia (7) |
| 4 | Machinery | North Carolina(2), South Carolina (2) |
| 3 | Rolling logs/debris | Arkansas (3) |
| 2 | Chainsaw | South Carolina (1), West Virginia (1) |
| 2 | Loading/unloading | Arkansas (1), North Carolina (1) |

As part of the FACE investigation process, we began identifying partners who could help disseminate FACE results and recommendations to the logging community. This was accomplished by providing FACE logging reports to the APA (which is now part of the Forest Resources Association [FRA]). APA would condense the information from a FACE logging report into a one-page document, incorporate the prevention recommendations, and distribute these to their members as safety news bulletins.

**Evaluation of Mechanical Harvesting Techniques**

Because of the high injury rate in logging, many State and Federal agencies as well as logger and industry groups have been working on ways to make logging safer. As part of this interest in identifying safer logging techniques, the AFF Program conducted a retrospective study to evaluate the impact of mechanized harvesting techniques on reducing logging injuries [Bell 2002]. The evaluation was based on the injury claim rate among West Virginia logging companies over the 6-year period from 1995 to 2000. (Appendix 4.3-02)

The study looked at the injury claim rate in 11 companies that used mechanized tree fellers. The overall injury claim rate for these companies was examined for about 2 ½ years before and about 2 years after they started using mechanical felling machines. The injury claim rate dropped significantly after mechanized felling began. The injury claim rate was 19.4 per 100 workers before mechanized felling compared with 5.2 per 100 workers after mechanized felling began. The injury claim rate for the rest of the West Virginia logging industry not using feller bunchers was 16.6 per 100 workers.

*Feller buncher harvesting hardwood trees.*

AFF Program staff also compared workers' compensation injury claim rates for 20 fully or partially mechanized companies and 68 nonmechanized (fully manual) companies participating in the West Virginia Logging Safety Initiative (LSI). Access to these data was made possible through collaboration with the West Virginia Forestry Association, the West Virginia Workers Compensation Commission, and the West Virginia Bureau of Employment Programs. This LSI program provided training to these companies to reduce the frequency and severity of logging injuries. The mechanized companies had an injury claim rate that was less than half that of the nonmechanized companies during the time they were in the LSI. This result demonstrates that mechanization can produce large reductions in injury claims, even within an LSI-trained group of loggers. It also highlighted the fact that even partial mechanization has substantial injury prevention benefits

### 4.3c Selected Outputs

#### Peer-Reviewed Publications

One AFF Program paper provided information showing that mechanized logging operations result in fewer injuries compared with manual timber felling operations. The State of West Virginia is looking at changing its workers' compensation rates based on a study by Bell [2002], which associates changes in logging injury rates with the use of feller bunchers in West Virginia.

Another AFF Program paper was the first peer-reviewed article using NTOF data that described fatal injury risks for loggers and how these risks vary in different parts of the United States [Myers and Fosbroke 1994]. This paper has been cited at least 19 times.

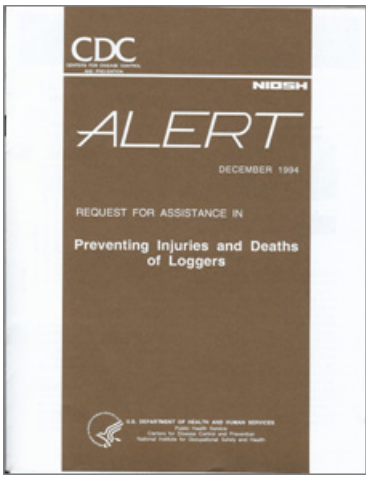
#### Conferences

Major workshops that lead to the adoption of helicopter logging standards within the State of Alaska and elsewhere include three workshops between 1993 and 1997 addressing the issue of helicopter logging crashes. The proceedings from these workshops are available in the NIOSH [1998], Helicopter Logging Safety: Alaska Interagency Working Group for the Prevention of Occupational Injuries.

### NIOSH Testimony

Testimony by NIOSH that influenced the final OSHA logging standard (especially in the areas of safe work practices, training, and first-aid requirements) is included in NIOSH. [1989], *NIOSH Testimony on Logging Operations, July 31, 1989*.

### Government Publications




On the basis of common risk factors identified in the FACE logging investigations, the AFF Program prepared a publication entitled *NIOSH Alert: Request for Assistance for in Preventing Injuries and Deaths of Loggers* in December 1994 [NIOSH 1994]. The Alert provides summaries of logging fatality statistics during this period, a synopsis of six fatal logging events, and a list of recommendations for logging operators and workers to prevent similar events in the future. As with the individual FACE reports, assistance was provided by APA to distribute this Alert to logging operators across the United States.

A criteria document prepared in 1976 [NIOSH 1976] was the basis for the final 1994 OSHA Logging Standard. The criteria document was entitled *NIOSH Criteria for a Recommended Standard: Logging from Felling to First Haul*.

Proceedings for the helicopter logging workshops highlighted above are contained in NIOSH [1998], Helicopter Logging Safety: Alaska Interagency Working Group for the Prevention of Occupational Injuries.

The AFF Program's peer-reviewed journal articles on logging have been cited 32 times in a variety of scientific journals (*Current Industrial Medicine Bulletin, Applied Ergonomics, Injury Prevention, Occupational Hazards, American Journal of Industrial Medicine, Journal of Safety Research, International Journal of Environmental and Occupational Health, Applied Ergonomics, Journal of Occupational and Environmental Medicine, Human and Ecological Risk Assessment, Journal of Forestry, Canadian Journal of Forest Resources, Forest Ecology and Management, Journal of Wildlife Management,* and *Forest Operations Review*).

### NIOSH Web Sites

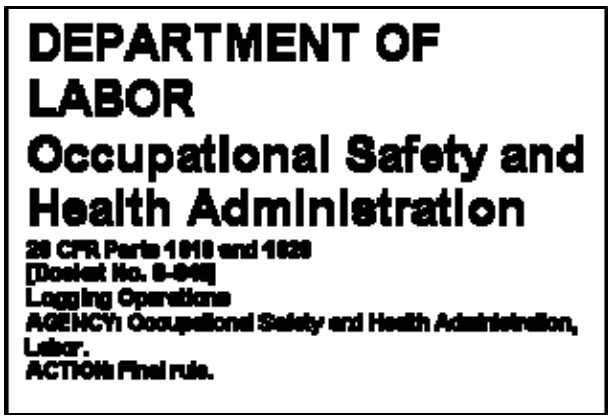
Logging Topic Page: http://www.cdc.gov/niosh/injury/traumalog.html#nioshpubs

FACE Logging Page: http://www.cdc.gov/niosh/injury/traumalgface.html

**A complete list of outputs can be found in section 4.5 at the end of this chapter.**

### 4.3d Intermediate Outcomes

OSHA used the NIOSH criteria document for a proposed logging standard [NIOSH 1976] as the basis for the 1994 OSHA logging standard [29 CFR[3] 1910.266]. Additional NIOSH recommendations for first-aid training requirements prohibited felling practices, personal protective equipment use, and equipment training requirements were adopted by OSHA in their logging standard.


DEPARTMENT OF LABOR
Occupational Safety and Health Administration
29 CFR Parts 1910 and 1928
[Docket No. S-046]
Logging Operations
AGENCY: Occupational Safety and Health Administration, Labor.
ACTION: Final rule.

Our findings from investigations of helicopter logging fatalities provided the basis for the development of interventions by the Alaska Interagency Working Group for the Prevention of Occupational Injuries in the summer of 1993 to prevent similar crashes in the future. These interventions included helping agencies such as the FFA, U.S. Forest Service, and the Alaska Department of Labor to share information about helicopter logging operations and thereby provide the basis for implementing these recommendations.

In March 1995, the Alaska Interagency Working Group for the Prevention of Occupational Injuries and the AFF Program cosponsored a Helicopter Logging Safety Workshop resulting in an improved prevention matrix for use in the logging industry. Additional workshops were held in 1996 and 1997 [NIOSH 1998]. Building on Alaska's leadership in this area, a Helicopter Logging Safety Committee was formed under the auspices of the HAI in January 1997. The goal of the committee is "to help promote the safe use of helicopters in all aspects of the helicopter logging industry." The committee has established its own helicopter logging guidelines, which address four issues: (1) general helicopter safety for forestry operations, (2) integration of ground and flight activities, (3) helicopter specific planning, and (4) a pre-accident plan [HAI 1997].

On the basis of HAI activities initiated by the AFF Program, the insurance industry has become involved by substantially discounting helicopter insurance costs for operators adhering to standards developed by the HAI Helicopter Logging Safety Committee.

Reports of AFF Program FACE investigations of logging fatalities were adapted by the APA (now part of the FRA), who distributed the case summaries and prevention recommendations to their membership.

[3] Code of Federal Regulations. See CFR in references

In 1997, the Instituto Mexicano Del Seguro Social, through the Pan American Health Organization's Center for Human Ecology and Health, requested assistance from the AFF Program to evaluate logging and wood processing plants in the Mexican State of Durango. In addition, the AFF Program was asked to provide training on how to plan and carry out injury and fatality investigations. The Program assigned the lead FACE logging investigator to Durango. During this assignment, nine site assessments were conducted with a class of 35 Mexican occupational medicine residents as part of the training process. These sites included active logging areas, sawmills, wood products processing facilities, and a paper mill. Hazard assessments were conducted for each site, and recommendations for hazard remediation were provided to the Instituto Mexicano Del Seguro Social.

Beginning in 1989, NIOSH decided to export the FACE model to the State level through its cooperative agreement and grants process. This resulted in the establishment of the State-FACE program. The primary purpose of State-FACE is to provide State health departments and other appropriate State agencies with the necessary training and resources to conduct FACE investigations for occupational fatalities occurring within their State. Since its inception, 22 States have participated in the State-Face program (Figure 4-8).

As part of this process, States are asked to conduct investigations of targeted fatalities identified by the NIOSH FACE program; however, States may also identify their own targeted investigations as well. For logging-related deaths, 65 State investigations were conducted between 1992 and 2004 in 12 different States (Table 4-11). Three States also identified logging fatalities as a State priority within their program. These were the States of Alaska, Kentucky, and West Virginia. Copies of all the State-Face logging reports are available on the NIOSH website: http://www.cdc.gov/niosh/injury/traumalgface.html.

**Table 4-11. State-FACE logging-related fatality investigations by State, 1992−2004**

| State | Logging fatality investigations |
|---|---|
| Alaska | 12 |
| California | 1 |
| Indiana | 1 |
| Kentucky | 21 |
| Michigan | 1 |
| Missouri | 1 |
| New Jersey | 1 |
| New York | 4 |
| Oregon | 4 |
| Washington | 3 |
| West Virginia | 13 |
| Wisconsin | 3 |

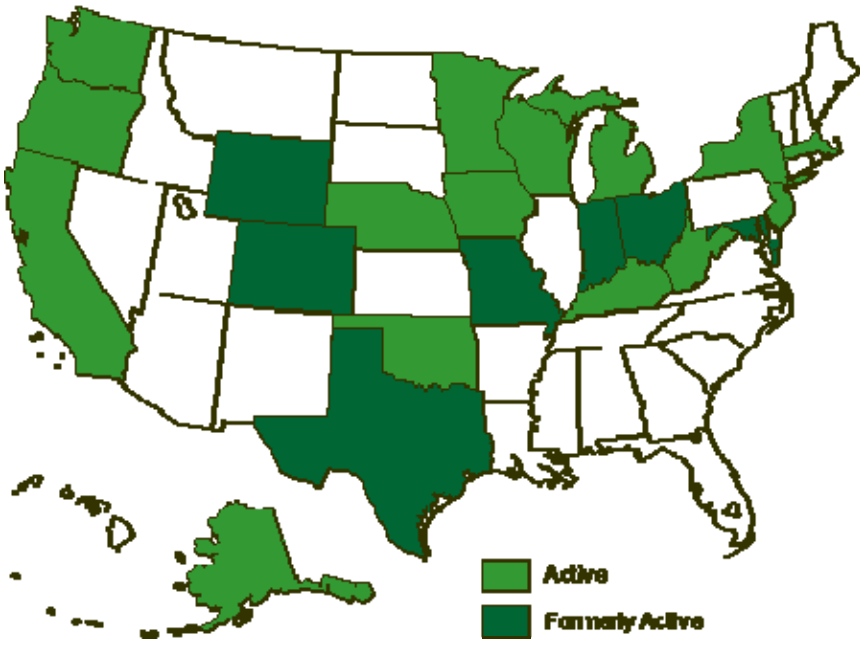



**Figure 4-8:** States that have or are currently participating in the NIOSH State-FACE Program.

The FRA continues to distribute the findings of NIOSH scientific research to its members. The Technical Release (05-R-31) *Mechanized Felling Reduces West Virginia WCI Claims* [NIOSH 2005] (based on the *Journal of Safety Research* publication) won an award in the FRA Appalachian Region Technical Writing Award Competition. It was also featured in their *Forest Operations Review* publication and featured in the July 2005 issue of *Occupational Hazards,* a general safety publication.

Intervention evaluation research by the AFF Program has shown that mechanized logging systems decrease injury rates in hardwood harvesting operations in the State of West Virginia. On the basis of these results, the West Virginia Workers' Compensation Board is holding meetings on incentives for logging companies, including establishment of a lower separate rate for mechanized logging companies. These lower rates could be instituted as early as January 2007.

### 4.3e End Outcomes

Since the initial release of the proposed OSHA logging standard in 1989, the national occupational injury and illness rate for the logging industry decreased from 19.5 to 6.4 cases per 100 full-time workers in 2003 (Figure 4-9) [BLS 2006].

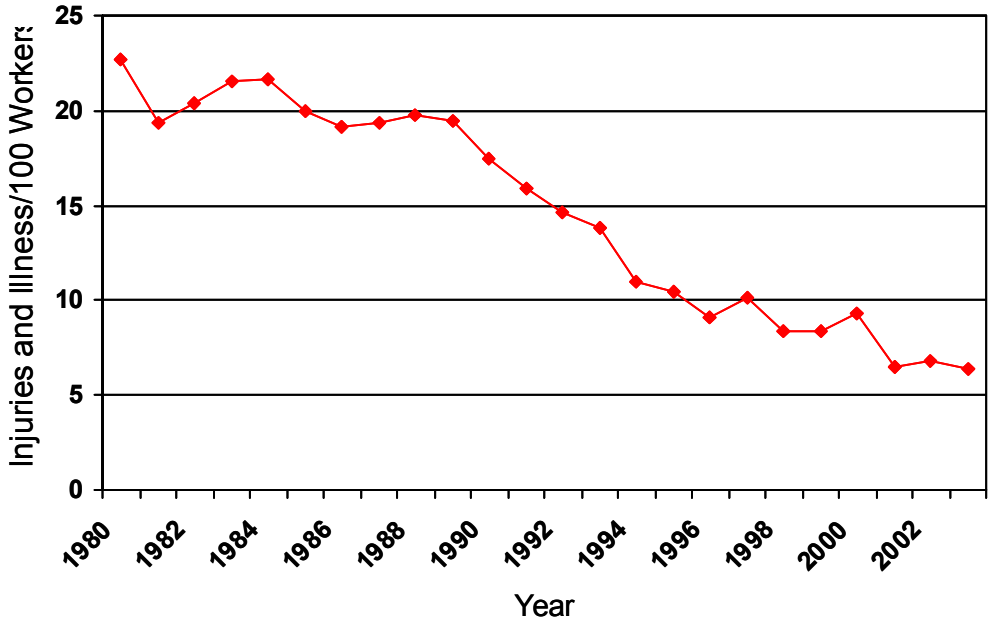



**Figure 4-9:** Occupational injury and illness rates per 100 full-time workers, 1980-2003.
*Source: Bureau of Labor Statistics Survey of Occupational Injuries and Illness.*

Nationally, occupational fatality rates have decreased from between 1984 and 2001, based on data from the NTOF surveillance system. Trends identified within NTOF are supported partly by logging fatality rates based on the BLS CFOI (Figure 4-10).

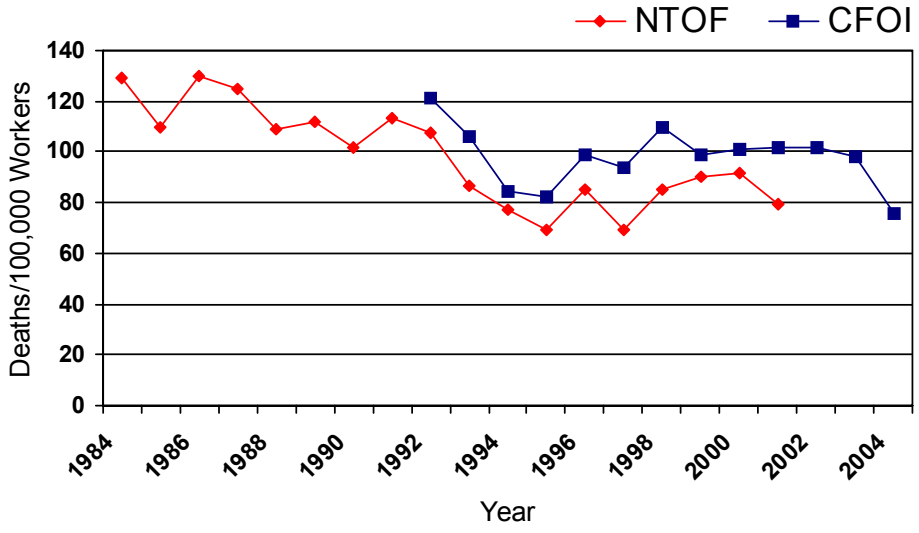



**Figure 4-10**: Occupational fatality rates for logging industry based on two fatality surveillance systems: NTOF [NIOSH 2006b] and CFOI [BLS 2006]

The six year average logging fatality rate before OSHA promulgated a national logging standard (based largely on the 1976 NIOSH criteria document [NIOSH 1976]) decreased 30% when compared with the 6-year period 1996-2001 (Figure 4-11).

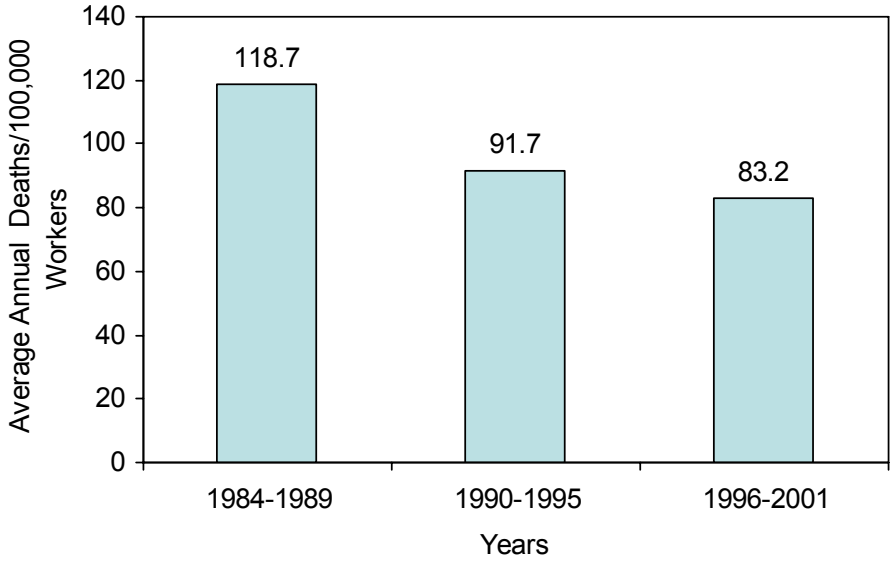



**Figure 4-11:** Changes in annual average logging fatality rates for three 6-year time periods between 1984 and 2001 *Source: NTOF [NIOSH 2006b]*

The AFF Program activities and outputs contributed to these declines.

Since the intervention and the implementation of the Alaska Working Group's recommendations to prevent helicopter logging crashes in July 1993, only one additional helicopter logging crash has occurred in Alaska. This July 1996 crash resulted in one fatality (Figure 4-12). No additional crashes have been reported in the State since that time.

AFF Program FACE investigations and reports conducted between 1991 and 1997 targeted two of the leading causes of death in logging—being struck by falling objects and machinery events. The summaries and recommendations were distributed nationally through the APA. Stuck by falling object rates decreased 38% and machinery deaths decreased 48% from the 6-year period 1984−1989 to the 6-year period 1996−2001 (Figure 4-13) [NIOSH 2006b]. AFF Program activities are likely to have contributed to that outcome.

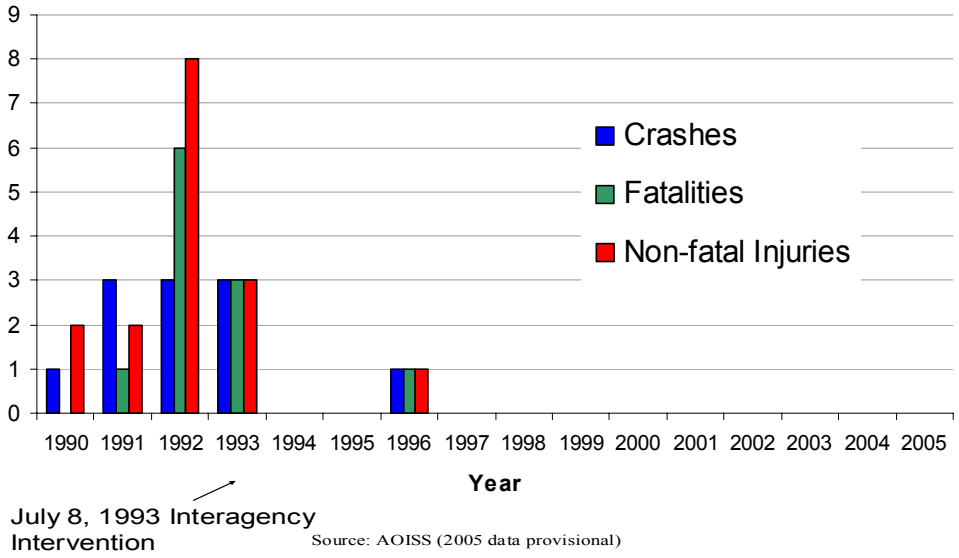



**Figure 4-12:** Crashes, fatalities, and nonfatal injuries in Alaska helicopter logging operations, 1990−2005. *Source: Original graph NIOSH AOISS [NIOSH 2002], updated through 2005 for this volume.*

### 4.3f Future Directions

The most recent BLS data from 2005 show that loggers still have the most dangerous occupation in the Nation, with a fatal injury rate of 92.4 deaths per 100,000 workers. The AFF Program will focus on quantifying determinants of State-level variations in logging fatality rates as an extenstion of the 1994 NIOSH publication [Myers and Fosbroke 1994] and OSHA's review of logging fatalities [OSHA 2000]. The program may also undertake a larger-scale study of the effect of in-the-field performance monitoring inspections on injury rates. A study of the barriers to job tenure in loggers (particularly for workers whose primary job task is chainsaw operator) is also warranted.

### 4.3g List of NIOSH projects included in this section

- AFS-9278893-Occupational Injury Prevention in Alaska (Appendix 4.3-01)
- DSR-9278807-Fatality Assessment and Control Evaluation (FACE) Project (Appendix 3.3-01)
- DSR-9278870-State-Based Fatality Surveillance Using Face Model (Appendix 3.3-02)
- DSR-9277123-Evaluating the Effectiveness of a Logger Safety Training Program (Appendix 4.3-02)

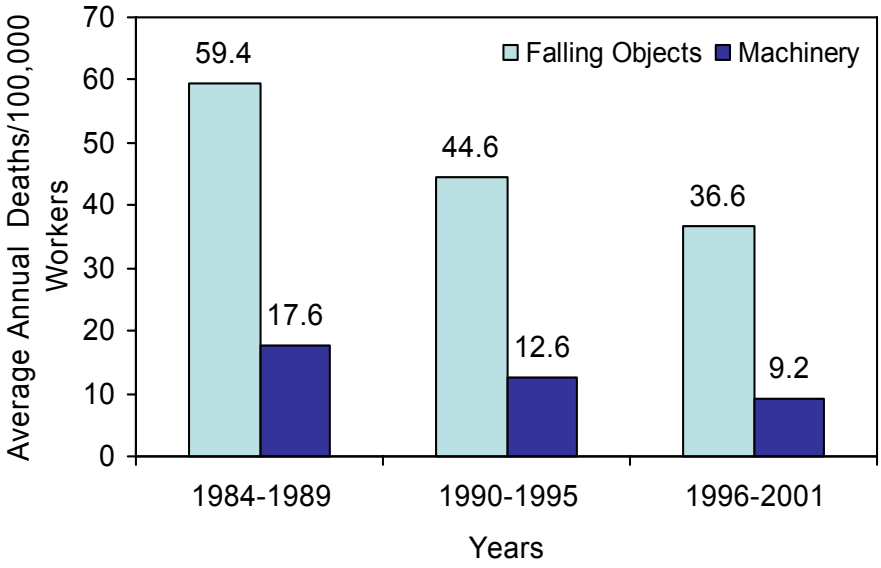



**Figure 4-13:** Changes in annual average logging fatality rates for three 6-year periods between 1984 and 2001: deaths due to falling objects and machinery. *Source: NTOF [NIOSH 2006b].*

## 4.4 Fishing

**4.4 Goal:** Reduce injuries, illnesses, and fatalities among commercial fishermen.

### 4.4a Challenge or Issue

Not long after the NIOSH Alaska Field Station (AFS) was established in 1991, it was clear that deaths related to commercial fishing were a principal contributor to Alaska's very high occupational fatality rate. Commercial fishermen face unique and extreme environmental risk factors because of the vast geography of the State, the remote locations of many fishing grounds, and lack of nearby rescue and emergency response systems. Alaskan commercial fishermen work the coldest waters of the United States. Cold weather and cold water contribute to worker fatigue and may exacerbate subsequent injuries. In 1991, the AFF Program began to examine work-related fatalities in Alaska. Early surveillance

Fishing crew on purse seine fishing vessel

data for commercial fishing fatalities showed that fatalities were primarily due to vessels sinking and falls overboard.

Unlike fatalities in the commercial fishing industry, most (67%) severe nonfatal injuries occur on deck during the deployment and retrieval of fishing gear in Alaska. The deck of a fishing boat is an unstable work platform that is constantly moving and often congested with machinery and fishing equipment. Much of the machinery and work processes in current use on commercial fishing vessels are rudimentary and have inadequate guarding or other safety measures. Injuries related to machinery and fishing equipment accounted for 40% of nonfatal injuries. These machinery-related injuries resulted from cables, chains, lines, winches, hydraulic "pot launchers," and other deck equipment. Being caught in a winch caused 35% of these machinery injuries. Another 27% were due to falls.

### 4.4b Approach

The AFF Program set a goal in the early 1990s to decrease commercial fishing fatalities (and the commercial fishing fatality rate) 50% by 2005. In 1991−1992, we established data-sharing agreements with the USCG and Alaska State Troopers and conducted our first direct onsite investigations of several fishing fatalities. We designed and implemented a comprehensive surveillance system for occupational fatalities, the AOISS. During this time, the AFF Program established a relationship with the State of Alaska and is able to use Alaska Trauma Registry (ATR) data for serious injuries resulting in hospitalizations for injury surveillance purposes. Through these methods, a comprehensive occupational injury surveillance system was established for all work-related injuries (fatal and serious nonfatal) that occurred in Alaska. We use injury information from both the ATR and AOISS to assess the most hazardous problems that commercial fishermen face, such as vessels sinking, falls overboard, and deck injuries. We have also identified high-risk groups based on type of fishing (e.g., crab fishing) and type of gear used in the fishing process (e.g., booms and deck winches) that deserve extra attention to create safe interventions. In addition to these surveillance activities, our scientists formed and facilitated an Interagency Working Group (IAWG). Members of this working group included experts from many organizations including the USCG, the AMSEA, and the NPFVOA.

We provided a scientific assessment of the most serious problems and identified high-risk groups. We supported the development of interventions through the IAWG, and evaluated interventions that have been implemented. We have also provided technical assistance on issues to provide scientific information for decision making. These activities have focused on the following areas (Appendices 4.3-01, 4.4-01, 4.4-02):

- prevention of vessel-related fatalities
- prevention of nonfatal work-related injuries
- prevention of fatalities due to loss of vessels

### 4.4c Selected Outputs

The AFF Program staff members have published dozens of scientific articles, NIOSH numbered documents, MMWR articles, and industry trade articles. In addition, we have sponsored two domestic and three international scientific conferences focusing on fishing vessel safety (Figure 4.14).

The following information highlights the most important outputs and transfers to date.

**Fishing Industry Safety and Health Workshop**

The AFF Program has worked with its partners to initiate and facilitate conferences and workshops on safety in the commercial fishing industry. The first conference was in Anchorage, Alaska in 1992. The objectives of this Fishing Industry Safety and Health Workshop were to raise consciousness, build coalitions, disseminate information, and encourage action to prevent injury and disease in fishing. A broad range of concerned parties described injury problems among fishers and suggested solutions to these problems. All papers presented at the conference were included in a proceedings volume. The proceedings for this conference were disseminated. The participants overwhelmingly encouraged action to improve safety for fishermen. Some participants identified preventive actions that can be implemented now, and others identified research actions that are needed to discover the causes of and the solutions to these problems. There were 77 people in attendance from Alaska and the West Coast.

**NIOSH Current Intelligence Bulletin**

Using AOISS, the AFF Program conducted the first major assessment of commercial fishing fatalities since the passage of the Commercial Fishing Industry Vessel Safety Act (CFIVSA) of 1988. These data were analyzed and the results were published in the NIOSH CIB [NIOSH 1997]. We found that there had been a decline in the fatality rate among commercial fishermen. However, there had not been a decline in the number of vessels sinking. The CFIVSA emphasizes the use and availability of safety equipment during and after a disaster at sea. We recommended augmenting this approach by preventing these disasters in the first place, as well as continuing to prepare to react to them if they occur. A total of 11 recommendations were made calling for more attention to the prevention of these events by focusing on the improvement of vessel stability, training, avoiding harsh weather, falls overboard, and deck safety. This document has been used by many organizations as a resource for discussing the dangers of the commercial fishing industry including the Alaska Department of Fish and Game, the Alaska Fishing Job Clearinghouse [AFJC 2005], CareMarx consumer health [Caremark 2006], The University of Vermont [University of Vermont 2000], WorkSafe BC in British Columbia [Work Safe BC 2006], and Trident Marine Association [Trident Marine Associates 2004].


**Figure 4-14: Timeline of NIOSH Research Activities Regarding Commercial Fishing Safety**

In addition to serving as a web resource, the USCG used the CIB to develop a national plan for fishing vessel safety. They convened a task force in 1988 after acknowledging that the national regulations focused on the reaction to the emergency at sea, but not the prevention of it. In the final report called "Living to Fish, Dying to Fish," the USCG had adopted 8 of the 11 recommendations that NIOSH had made in the CIB to improve fishing vessel safety. The CIB also served as the cornerstone for the 1997 Fishing Industry Safety and Health (FISH) Workshop in Seattle, Washington.

**FISH Workshop**

The AFF Program sponsored and organized a FISH II workshop in Seattle in 1997. The CIB provided the scientific support and identified the most hazardous areas requiring immediate attention. Members of the IAWG were present, as well as others interested in the safety of this industry. The workshop's goal was to describe current circumstances and plan the next steps to ensure that fishermen have relatively safe workplaces.

The first workshop day defined the current problem and identified the populations at risk. The second day, participants were asked to participate in working groups. The working groups were:

- prevention of vessel-related fatalities
- prevention of Man Overboard (MOB) fatalities in the industry
- prevention of diving fatalities in the commercial fishing industry
- prevention of nonfatal work-related injuries

Each of these working groups developed recommendations that were published in the conference proceedings [NIOSH 2000]. Many of these recommendations led to successful interventions including: the NIOSH Deck Safety Project, the USCG Pre-season Dockside Inspection Program of Bering Sea crab vessels (see Intermediate Outcomes for details), and the Lobstermen Entanglement Prevention Project in Maine led by the Harvard School of Public Health. Information was used in marine safety training offered by AMSEA.

**Line Entanglement in the Lobster Fishery**

As a result of connections made during the FISH II conference in Seattle, the Harvard School of Public Health asked us to assist them with a study to reduce falls overboard on Maine lobster vessels. Researchers from Harvard had found that during 1993-1997, Maine lobstermen had a work-related fatality rate of more than 2.5 times the national average for all industries. Anecdotally, lobstermen indicated that entanglement of workers in the line attached to the lobster traps was the most likely cause of many fatalities. The joint project:

- gathered data on the prevalence of personal entanglement in trap line
- sought to understand the work practices associated with entanglement

- identified work practices and engineering controls that could be used to prevent fatalities

The study resulted in recommendations to prevent injuries from entanglements including work practices and engineering controls that:

- reduced the risk of entanglement
- helped the escapement from an entanglement
- facilitated re-boarding in the event that someone was pulled over

The findings from this project were compiled and published by Harvard in an industry-specific publication, "Lobstering Safety Secrets Revealed" [Harvard 2001] and distributed to commercial lobstermen in Maine. Two peer-reviewed articles were published, as well as a NIOSH Workplace Solutions document.

## Deck Safety Products

In October 2000, the AFF Program started the "Deck Safety Project". This project is based on findings from the nonfatal injury data from the Alaska Trauma Registry. The goal of this project is to find practical solutions to fatal and nonfatal injuries and assist in preventing fatalities by disseminating the information to partners in the safety field and the commercial fishing industry. There were 574 severe nonfatal injuries that occurred in the commercial fishing industry during 1991-1998. This is equivalent to an annual rate for serious hospitalized injuries of 410/100,000 full-time fishermen.

*Working deck of purse seine fishing vessel*

The purpose of this project is to identify practical solutions to deck safety problems and disseminate the information to fishermen. The first phase of this project concentrated on deck safety for crab fishermen. We worked with NPFVOA and conducted focus groups with crab fishermen and toured vessels to view and discuss deck safety problems and potential modifications. Information about work practices and opinions regarding the effectiveness of the interventions for particular deck safety problems were received by crab fishermen. The modifications that were thought to be good solutions were published with illustrations and general installation instructions in the Deck Safety Handbook for Crab Fishermen [Jensen Maritime Consultants 2002]. A 1/10 scale deck safety model was built that illustrated all of the items in the deck safety booklet. This deck model is used at industry tradeshows to demonstrate the ideas in the booklet when discussing deck safety.

After this work, the project shifted to other types of vessels. We worked with USCG and the AMSEA to conduct focus groups with fishermen in Southeast Alaska. Findings from these focus groups revealed that fishermen were concerned about deck safety, and in particular, with the deck winch on purse seine vessels, which poses an entanglement risk.

Based on these findings, the AFF Program designed and tested a method of quickly stopping the deck winch. This type of winch requires the operator to stand near it during operation. Fishermen who lose their balance or are inattentive can become entangled in the purse line as it is winding onto the "gypsy" drum. Crushing injuries to the hand or arm (and in some cases fatalities, if the head or torso is caught) are the inevitable result.

*The "e-stop" mounted on the deck winch*

AFF Program engineers designed an emergency-stop (e-stop) system that allows the winch to be quickly stopped by a worker, even if the worker is caught in the winch. A fishing vessel captain and owner in Seattle, Washington partnered with us on the design and installation of the e-stop system, which was successfully tested during the 2005 and 2006 Alaska salmon seasons. Crewmembers praised the device as a significant safety and productivity improvement, and they continue to use the system.

The success of these first two stages of the Deck Safety Project demonstrates the effectiveness of combining diverse expertise to solve fishing safety problems. More than 4,000 copies of the Deck Safety Handbook have been distributed to fishermen in the Northwest, and a copy is posted on several safety websites as a resource. The e-stop system has received strong support at industry trade shows. It was demonstrated at the Pacific Marine Expo in Seattle, the largest commercial fishing trade show in the United States, with many vessel owners and operators requesting information on how to obtain the device. Work continues to produce a video on deck safety, develop a commercially available retrofit kit for the e-stop (in collaboration with the original switch manufacturer), and to publish a control technology publication to increase the distribution and impact of the e-stop.

## IFISH I, II, III

In 2000, the AFF Program and Harvard SCHOOL OF PUBLIC HEALTH staff partnered to organize the 1st International Fishing Industry Safety and Health (IFISH) Workshop in Woods Hole, Massachusetts [NIOSH 2002]. This conference was designed to discuss issues in fishing safety on an international scale. More than 100 fishermen and safety professionals from 13 different countries gathered to discuss fishing vessel safety issues. Topics covered included a summary of worldwide

problems and challenges in the industry, innovative approaches to investigating and preventing fishing vessel casualties, risk perception, intervention programs, surveillance, and unique approaches to safety training.

This was followed by the Second IFISH (IFISH II) conference in 2003. We partnered with AMSEA to convene and facilitate this conference in Sitka, Alaska. There were 135 registrants from 18 nations. A total of 40 speakers addressed topics ranging from deck safety needs for crabbers working in northern waters to policy changes affecting Pacific Island States. There were 7 speakers sponsored by the Food and Agriculture Organization (FOA), who provided overviews of commercial fishing safety programs in developing countries including: Tonga, Sri Lanka, Pakistan, India, Senegal, and Chile. The proceedings volume includes manuscripts submitted for 28 of the 40 presentations [NIOSH 2006].

Most recently, another conference, IFISH III (also co-sponsored by the AFF Program), took place in Chennai, India in early 2006. These international conferences disseminate research on fishing vessel safety from many parts of the world. The conference in India focused on small scale artesian fishermen and unique safety concerns for this group of workers.

**Full-Time Equivalent Estimates**

Enumerating fishermen to calculate rates is very difficult. Since fishermen are primarily a self-employed workforce, they do not have as many benefits or record-keeping requirements as other occupations. For example, there is generally no health insurance or workers' compensation coverage for commercial fishermen. Fishing is generally a non-unionized workforce with no monitoring of work hours, time at sea, or grievances. There are also few fisheries that are in existence year round. A fisherman may only fish for a few months a year. For all of these reasons, estimating the number of fishermen is very difficult.

The AFF Program designed a way to estimate a full time equivalent fisherman for each fishery and for the workforce. This allows us to compare rates of fatalities and injuries to other Alaskan workers. It also allows us to identify the most hazardous fisheries in Alaska to focus interventions.

**A complete list of outputs can be found in section 4.5 at the end of this chapter.**

### 4.4d Intermediate Outcomes

**Pre-season Dockside Inspection Program**

In follow-up to the working groups from the 1997 FISH Workshop in Seattle, the USCG in Alaska designed and implemented a Pre-season Dockside Inspection Program. USCG personnel had participated in the vessel loss prevention working group and took the lead in designing a plan to prevent vessels from sinking. USCG vessel safety examiners developed a comprehensive "at-the-dock" boarding and

inspection program to identify and correct safety hazards known to exist in the Bering Sea crab fisheries. These fisheries were chosen based on NIOSH findings identifying the crab fishery with the highest fatality rate of any fishery in Alaska. Bering Sea crab fishing requires the use of crab "pots" that are 600-800 lb. steel cages to catch crab on the ocean floor. A vessel improperly loaded with crab pots, or a vessel that is covered in ice, may become dangerously unstable and capsize.

This Pre-season Dockside Inspection Program examines a large number of vessels within the fleet prior to the crab fishery opening. The examiners review vessel stability information with vessel masters and check lifesaving equipment required by the CFIVSA. If the vessel is not loaded properly, or if there is a lack of lifesaving equipment, a Captain of the Port Order is issued and the vessel is not able to fish until the discrepancy is corrected.

In winter 2005, the USCG requested that the AFF Program assist them in the evaluation of the Pre-season Dockside Inspection Program. We showed that from implementation in October 1999 until 2005, there had been 1 fatality in this fishery, which was due to a fall overboard versus an average of ~7 in each of the prior 5 years. However, another fall overboard occurred in January 2005, and the fishing vessel "Big Valley" sank resulting in 5 fatalities. The crab industry strongly supports this the Pre-season Dockside Inspection Program initiative.

**Marine Safety Training**

The CFIVSA regulations include a requirement that fishermen conduct monthly emergency drills, and that these drills be observed by a Certified Drill Conductor. In 1993, AMSEA received its first NIOSH Training Project Grant, to help train fishermen to meet the requirement to be qualified to become Drill Conductors for these required monthly drills.

AMSEA and the AFF Program have worked on many projects on fishing vessel safety since the early-1990s. These projects include a dive safety workshop and a deck-safety pamphlet [AMSEA 2002] that was sent to fisherman in Alaska and distributed at the 2nd IFISH Workshop in Sitka, Alaska in 2003.

AMSEA has requested technical assistance from the AFF Program to evaluate the effectiveness of their training in the prevention of commercial fishing fatalities. We compared the number of survivors of commercial fishing vessels which sunk to the number of victims (fatalities) of these vessels which sunk, and found that victims were 1.5 [95% Confidence Interval (CI) 0.9, 2.4] times more likely not to have had training. Although the CI contains 1.0, generally as sample size increases, the width of the CI decreases. With additional information on people trained, this interval should decrease and may show a statistically stronger association between the lack of training and being a victim.

In the same study, AFF Program scientists found that victims of commercial fishing vessel sinking were 7 times (95% CI 1.9, 27.4) more likely not to have worn an

immersion suit, and 15 times (95% CI 4.6, 50.8) more likely not to have used a life raft. Being trained on how to use this equipment quickly and efficiently is necessary. AMSEA uses this information to seek funding and to promote their courses.

AMSEA has used AFF Program reports of commercial fishing fatalities and injuries to better understand the nature of the problems in the industry. AMSEA reports that this has been extremely useful for strategically planning in what areas of the fishing industry to focus training efforts. Since 1992, AMSEA has held more than 1,000 classes and trained more than 15,000 fishermen.

**Technical Assistance for Fishery Management**

This section highlights AFF Program input into fishery management regime decisions since 1992.

To prevent the depletion of fish stocks as the competition for these stocks increases, each fishery (fishery: defined by species, time, and place) has its own management plan. The challenge is to keep fisheries at sustainable levels to fish, while not ruining the economy of the fishing communities that depend on this resource. Fisheries management plans can limit the number of participants, or limit the type or amount of gear that can be carried. They can also put geographic restrictions on fishing areas and limit the number of minutes, hours, or days fleets can fish. There are other fisheries with limits on the total weight of the catch across the fleet without the use of major time constraints. The National Standards in the Magnuson-Stevens Fishery Conservation and Management Act includes 10 standards that fishery management plans must follow. One of them is that "Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea." (16 U.S.C. 1851, Sec.201.)

Fisheries management regulations that result in short seasons sometimes cause fishermen to pursue other fish, perhaps in waters for which their vessels were not designed. In addition, they may have to change to new unfamiliar fishing gear increasing the chances for accidents to occur.

In 1995, Individual Fishing Quotas (IFQs) were implemented. The IFQ program awarded vessel owners an allowable catch limit or quota based on catch records from the previous five years. Also, they had from April to September to catch their share of fish. In 1997, the Ocean Studies Board of the National Research Council asked the AFF Program to provide testimony regarding the implications this change in the management of the halibut/sablefish fishery had on safety. We analyzed USCG data and showed that Search and Rescue missions significantly declined by 63% ($p=0.009$) after implementation of the IFQ system. We also reported that 9 fishermen died while fishing for halibut during 1992-1994, but since implementation of the IFQ's, no fatalities had occurred in the fishery.

Another quota-based management system was recently implemented in the Bering Sea crab fisheries. Although our personnel did not provide testimony in person, our

publications on the safety record of this fleet were used as foundation evidence that this is a dangerous fishery. The NIOSH AFS AFF Program researchers were cited in the member package which was distributed at one or more of the meetings where this proposed system was debated.

### 4.4e End Outcomes

While the work-related fatality rate for commercial fishermen in Alaska is still very high, fatalities are decreasing. Since 1990, there has been a 74% decline in deaths of commercial fishermen in Alaska, and a 51% decline in the annual fatality rate (Figure 4-15).

The successes in improving safety in the commercial fishing industry in Alaska are multifaceted. Our approach is to:

- Offer a scientific assessment of the worst problems. We did this by analyzing injury and fatality data and making recommendations.
- Identify high-risk groups through estimating denominators and calculating rates.
- Support the development of interventions by providing scientific information on which to base the interventions.
- Evaluate interventions to assess any change in the number and rate of fatalities and injuries.

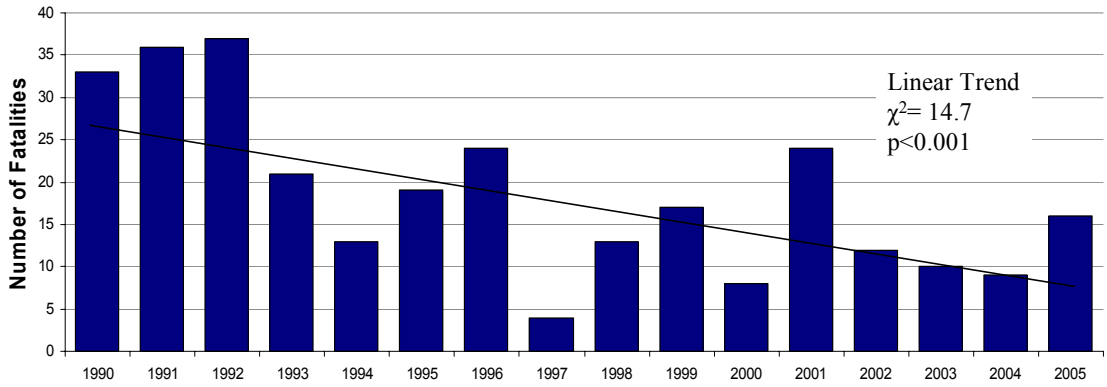



**Figure 4-15:** The decline of commercial fishing fatalities in Alaska from 1990-2005 (n=296).

We conducted the early assessment of the decline in commercial fishing fatalities after the implementation of the Fishing Vessel Safety Act. We found that although fatalities had decreased, vessel sinking events had not. In addition, we identified the fishery in which each fatal event had occurred. We showed that the crab fishery in the Bering Sea was the most hazardous fishery in the State, and that the problem was the loss of fishing vessels. Bringing our partners together at the FISH Workshop in Seattle in 1997, we organized the working group to prevent vessels from sinking. This resulted in the 1999 Pre-season Dockside Inspection Program.

The crab industry strongly supports this dockside enforcement initiative. Fishing fatalities continued to decline through 2005. In particular, these fatalities declined among crab fishermen (Figure 4-16). In winter 2005, the USCG requested that we assist them in the evaluation of the Pre-season Dockside Inspection Program. We showed that since its implementation in October 1999 until 2005, there had only been 1 fatality in this fishery, which was due to a fall overboard. In January 2005, however, another fall overboard occurred and the fishing vessel "Big Valley" sank, resulting in five fatalities.

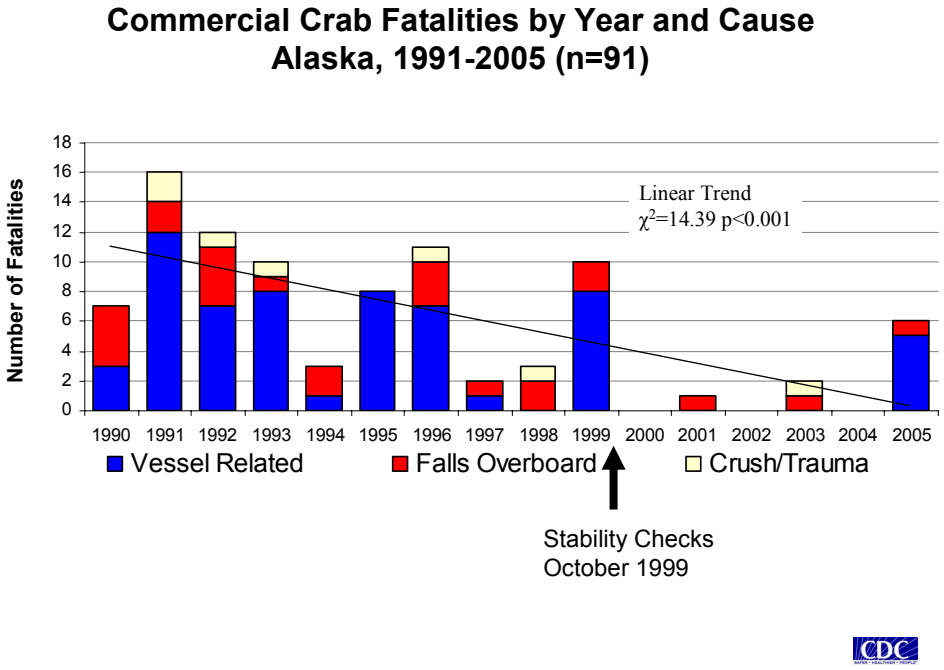



**Figure 4-16:** The decline in crab fishing fatalities from 1990-2005. Note the start of stability checks.

When looking at fatality rates for the 1990s versus the rates since 2000, the rate has dropped by more than 50% among crab fishermen (Figure 4-17). These types of analyses and interventions have not occurred in other parts of the country.

In addition to addressing fatal injuries in the industry, we analyzed nonfatal injuries, identifying deck machinery as a dangerous hazard with a need for practical solutions to prevent these disabling injuries. The USCG is the agency with the regulatory authority for the safety of the fleet. As an agency, they have not addressed nonfatal injuries. The AFF Program, through the NIOSH AFS, has led the way in highlighting deck hazards as an important safety area.

### 4.4f Future Directions

**Management Regimes Impact on Safety**

NIOSH recommends that all current and proposed management regimes be examined for safety concerns [NIOSH 1997]. Management of fisheries must ensure the preservation of the resource while optimizing the opportunities for fishermen, and must allow fishermen the freedom to exercise judgment about the advisability of fishing in current conditions. Fisheries management regimes can be changed to not only benefit the fish stocks, but also protect the fishermen from harsh weather or long work hours by eliminating the race to fish. Fishermen participating in a quota-based management system can choose the weather in which to catch their share of fish.

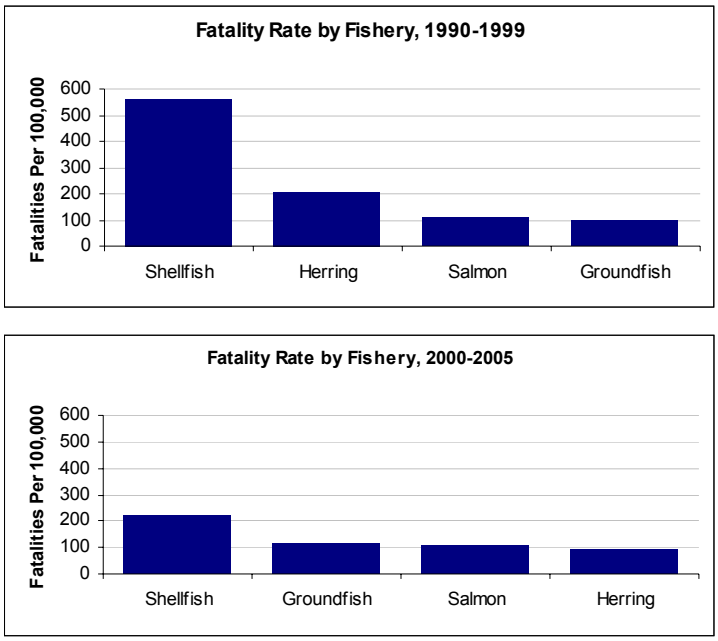



**Figure 4-17:** The change in the Fishery-specific fatality rate. Fatality rate from 1990-1999 compared to 2000-2005

AFF Program scientists successfully competed for a grant in 2005 from the North Pacific Research Board to evaluate the impact of the changes in fishing management regimes on safety in the halibut/sablefish fleet and the Bering Sea Aleutian Island pollock fleet. Despite the assertion by fishery managers, industry leaders, and in academic circles that vessels operating in a quota-based fishery are generally safer, there has been no systematic assessment to examine corresponding improvements in measures of safety. Rates of injuries, fatalities, search and rescue missions, and vessel sinking in fishing fleets both before and after changes in fishing management need to be examined. This systematic assessment of the change in these rates will provide more scientific evidence to support policies made by fisheries managers.

**Expanding Research Program**

We are expanding on the successful work in Alaska to include other commercial fishing regions of the country during 2007. This research program consists of four projects, which apply classic epidemiologic and engineering analysis methods to better understand and prevent commercial fishing fatality and injury events.

The first project is Coordination and Analysis. This project provides the core activities of data surveillance and analysis, epidemiologic expertise, and communication activities for the entire program. It provides ongoing surveillance for fatal and nonfatal fishing injuries and produces annual informational updates on research findings, current hazards, and trends. Additionally, the Coordination and Analysis Project establishes and coordinates research partner meetings at the annual Pacific Marine Expo, and will co-sponsor the next IFISH Conference.

The second project is Commercial Fishing Risk Factors and Prevention Strategies. This project's overall objective is to identify risk factors for commercial fishing fatalities for the three geographic areas which comprise the U.S. coastline, and to develop tailored injury prevention interventions. It provides a descriptive epidemiologic analysis of fatal incidents based on event, vessel, and individual factors. There will also be a comparative analysis on all vessel sinking events that have occurred in the United States from 1994-2006. The results of this project will be communicated to the USCG, maritime safety organizations, and industry so that stronger prevention and education interventions can be developed through the coordination project.

The third project is Reducing Fatalities Due to Falls Overboard, intended to reduce injuries and fatalities due to falling overboard from commercial fishing vessels. This project will involve analyzing falls overboard to understand root causes and possible interventions. It will develop improvements to deck designs or fishing equipment that can prevent falls overboard, and will evaluate commercially available crew overboard alarms, tracking devices, and rescue devices. Further, this project will design new, innovative crew overboard interventions and evaluate them on fishing vessels.

The final project is Deck Machinery Hazards Research and Development. The long-term objective of this project is to reduce fatalities and severe nonfatal injuries related to machinery on the working decks of vessels in the North Pacific commercial fishing fleet. Specifically, this project will attempt to reduce the incidence of machinery entanglements through continued development of emergency-stop (e-stop) and guarding technologies, and will attempt to reduce the incidence of long-liner hook injuries.

Further research is also underway at the NIOSH Spokane Research Laboratory aimed at reducing commercial fishing fatalities by focusing on the problem of sinking and capsizing. Sinking and capsizing are among the most dangerous of accidents at sea. Vessels can sink or capsize from a combination of factors such as overloading with catch, inability to quickly clear water from the deck, unnoticed leaks, and down-

flooding through open hatches, doors, and uncovered well decks. This project's goal is to eliminate drowning associated with vessel sinking and capsizing by inventing new ways to detect, monitor, control, and prevent dangerous, uncontrolled down-flooding that can sink an otherwise intact, seaworthy vessel.

### 4.4g List of NIOSH projects included in this section

- AFS-9278893-Occupational Injury Prevention in Alaska (Appendix 4.3-01)
- AFS-9277394-Injury Prevention in the Commercial Fishing Industry (Appendix 4.4-01)
- AFS-92700BL-Deck Safety for Commercial Fishing Vessels (Appendix 4.4-02)

## 4.5 Outputs

### 4.5a Child Labor

#### Dissemination of Outputs

NIOSH has worked extensively with NASS to disseminate survey results and recommendations for keeping youth safe on farms. NASS has distributed more than 100,000 NIOSH pamphlets to farm operators across the United States, including pamphlets specifically targeting minority farm operators. These pamphlets summarize common causes of childhood farm injury and steps to foster safe and healthful farm environments for children.

National FFA and DOL representatives from the Federal Interagency Working Group on Preventing Childhood Agricultural Injuries have agreed to help disseminate brochures on findings and recommendations of the latest childhood agriculture injury surveillance.

In the three years since its release, more than 31,000 copies of the *NIOSH Young Worker Alert* have been distributed. Examples of groups through which it has been disseminated include the following:

- Maryland Occupational Safety and Health (MOSH) Training and Education; 100 copies distributed in the Teen Train-the-Trainer program
- Virginia Department of Labor and Industry; 50 copies used for consultation program
- Massachusetts Fatality Assessment and Control Evaluation program; 560 copies sent to the Massachusetts Department of Education
- Nebraska Fatality Assessment and Control Evaluation program; distributed at every presentation, briefing, or booth attended by program staff, including "Husker Harvest Days" and "Farm Safety Day Camps."

### Conferences Sponsored

Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective, November 90–11, 1997, Indianapolis, IN.

Prevention of Musculoskeletal Disorders for Children and Adolescents Working in Agriculture, May 6–7, 2002, Cincinnati, OH.

Special Session: Childhood Agricultural Injuries, Fourth International Symposium: Rural Health and Safety in a Changing World, October 18–22, 1998, Saskatoon, Saskatchewan, Canada.

Special Session: Childhood Agricultural Injuries, Agricultural Safety and Health in a New Century, April 28–30, 2000, Cooperstown, NY.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Special Session: Childhood Agricultural Injuries, National Institute for Farm Safety 2001 Annual Meeting, June 24–27, 2001, Pittsburgh, PA.

Special Session: Intervention—Safe Behaviors among Adults and Children, Surgeon General's Conference on Agricultural Safety and Health, April 1991 Des Moines, IA.

Special Session: Agricultural Injuries, National Injury Prevention and Control Conference, May 9–11, 2005, Denver, CO.

2001 Summit on Childhood Agricultural Injury Prevention, April 30–May 1, 2001, Brooklyn Park, MN.

### Data bases

NIOSH has established four new surveillance systems as part of the childhood agricultural injury prevention initiative:

- Childhood Agricultural Injury Survey (CAIS): data available for 1998, 2001, and 2004.
- Childhood Agricultural Mortality System (CAMS): data available for 1995–2003.
- Minority Childhood Agricultural Injury Survey (M-CAIS): data available for 2000 and 2003.
- National Agricultural Workers Survey (NAWS) Youth Injury Module: data available for 1999, 2001–2004.

### NIOSH Testimony

NIOSH [1994]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor, Wage and Hour Division advance notice of proposed rulemaking on child labor regulations, orders and statements of interpretation, October 25, 1994. Cincinnati, OH: U.S. Department Health, Education, and Welfare, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

### Publications

Adekoya N, Pratt SG [2001]. Fatal unintentional farm injuries among persons less than 20 years of age in the United States: Geographic profiles. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001–131.

Adekoya N, Castillo DN, Myers JR [1998]. Youth agricultural work-related injuries treated in emergency departments—United States, October 1995–September 1997. MMWR *47*(35):733–737.

Allread WG, Wilkins JR III, Waters TR, Marras WS [2004]. Physical demands and low-back injury risk among children and adolescents working on farms. J Agric Safety Health *10*(4): 255–272.

Bartels S, Niederman B, Waters TR [2000]. Job hazards for musculoskeletal disorders for youth working on farms. J Agric Safety Health *6*(3):191–201. (ISI Web of Science: Cited 4 times as of 11/20/06)

Castillo DN, Adekoya N, Myers JR [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992–1996. J Agromed *6*(3):27–41. (ISI Web of Science: Cited 12 times as of 11/20/06)

Castillo D, Hard D, Myers J, Pizatella T, Stout N [1998]. A national childhood agricultural injury prevention initiative. J Agric Safety Health Special Issue 1:183–191. (ISI Web of Science: Cited 2 times as of 11/20/06)

Goldcamp EM, Hendricks KJ, Myers JR [2004]. Farm fatalities to youth 1995–2000: a comparison by age groups. J Safety Res *35*(2):151–157. (ISI Web of Science: Cited 1 time as of 11/20/06)
Hard DL, Myers JR [2006]. Fatal work-related injuries in the agriculture production sector among youth in the United States, 1992–2002. J Agromedicine 11(2): 57-65.

Hard DL, Myers JR, Gerberich SG [2002]. Traumatic injuries in agriculture. J Agric Safety Health *8*(1):51–65. (ISI Web of Science: Cited 4 times as of 11/20/06)

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J [1999]. Young workers at risk when working in agricultural production. Am J Ind Med *36*(Suppl l):31–33. *(cited 13 times per Google Scholar)*

Hendricks KJ, Adekoya N [2001]. Non-fatal animal related injuries to youth occurring on farms in the United States, 1998. Injury Prevention 7(4):307-311. (ISI Web of Science: Cited 4 times as of 11/20/06)

Hendricks KJ, Goldcamp EM, Myers JR [2004]. On-farm falls among youth less than 20-years old in the U.S. J Agric Safety Health *10*(1):27–38.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR [2005]. Injuries to youth living on U.S. farms in 2001 with comparison to 1998. J Agromed *10*(4):19–26.

Hendricks KJ, Myers JR, Layne LA, Goldcamp EM [2005]. Household youth on minority operated farms in the United States, 2000: exposures to and injuries from work, horses, ATVs and tractors. J Safety Res *36*(2):149–157.

Kidd P, Draime J [1998]. Non-traumatic, work-related, musculoskeletal disorders in farm youth. Unpublished final report, NIOSH Contract #79278284.

Landsittel D, Hard DL, Murphy DJ, Kiernan NE [1998]. The Pennsylvania Central Region Farm Safety Pilot project: Part II—Baseline data associations between approach-to-safety and hazard conditions. J Agric Safety Health Special Issue *1*:21–28. (ISI Web of Science: Cited 3 times as of 11/20/06)

Landsittel D, Murphy DJ, Kiernan NE, Hard DL, Kassab C [2001]. An evaluation of the effectiveness of educational interventions in the Pennsylvania Central Region farm safety pilot project. Am J Ind Med *40*(2):145–152. (ISI Web of Science: Cited 4 times as of 11/20/06)

Mardis AL, Pratt SG [2003]. NIOSH Alert: Preventing deaths, injuries, and illnesses of young workers. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003–128.

Mason RW, ed. [1995]. Report to Congress on workers' home contamination study conducted under the Workers' Family Protection Act [281 pages]. NIOSH, U.S. Dept Health and Human Services, Cincinnati, OH. September, 1995. (Cited 17 times per Google Scholar) *Dr. Hard developed a section devoted to caustic farm products. Farms were also highlighted (dealing with caustic substances ingested by children and pesticide exposures) along with sections on caustic farm products and pesticides*.

Myers JR [1998]. Injuries among farm workers in the United States—1994. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health

Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98–153.

Myers JR [2001]. Injuries among farm workers in the United States, 1995. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001–153.

Myers JR, Hendricks KJ [2001]. Injuries among youth on farms in the United States, 1998. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001–154.

Myers JR, Hendricks KJ, Goldcamp EM, Layne LA [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume I: Racial minority national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005–147.

Myers JR, Hendricks KJ, Layne LA, Goldcamp EM [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume II: Hispanic national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006–109.

Murphy DJ, Kiernan NE, Hard DL, Landsittel D [1998]. The Pennsylvania Central Region farm safety pilot project: Part I—Rationale and baseline results. J Agric Safety Health *4*(1):25–41. (ISI Web of Science: Cited 2 times as of 11/20/06)

Myers JR, Adekoya N [2001]. Fatal on-farm injuries among youth 16 to 19 years of age: 1982–1994. J Agric Safety Health *7*(2):101–112. Myers ML, Herrick RF, Olenchock SA, Myers JR, Parker JE, Hard DL, Wilson K, eds. [1992]. Papers and Proceedings of the Surgeon General's Conference on Agricultural Safety and Health. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 92–105. *(cited 20 times per Google Scholar)*

NIOSH [2002]. Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders—May 3, 2002. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety And Health.

NIOSH [2004]. Injuries to youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–117.

NIOSH [2004]. Asthma among household youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–118.

NIOSH [2004]. Worker Health Chartbook, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–146 (*Agricultural fatality and nonfatal injury section, pp. 195–211).*

NIOSH [2004]. Injuries to youth on Hispanic farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–157.

NIOSH [2004]. Asthma among household youth on Hispanic farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–158.

NIOSH [2004]. Injuries among youth on farms, 2001. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2004–172.

Parker DL, Wahl GL, Higgins D [1999]. Childhood work-related agricultural fatalities— Minnesota, 1994-1997. MMWR *48*(16):332–335.

Pollack SH, Struttmann TW, Zwerling C, Lundell J, Johnson W, Etre L, Hanrahan LP, Tierney J, Higgins D [1999]. Deaths among children aged less than or equal to 5 years from farm machinery runovers—Iowa, Kentucky, and Wisconsin, 1995–1998, and United States, 1990–1995. MMWR *48*(28):605–608. (ISI Web of Science: Cited 1 time as of 11/17/06)

USDA [1999]. 1998 Childhood agricultural injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 8 (10–99).

USDA [2002]. 2000 Childhood agricultural injuries on minority-operated farms. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (02).

USDA [2004]. 2001 Childhood agricultural-related injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (1–04).
Waters TR, Wilkins JR III.. [2004]. Conference proceedings: prevention of musculoskeletal disorders for children and adolescents working in agriculture. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2004–119.

**Publications (NIOSH Fatality Assessment and Control Evaluation (FACE) Reports)**

NIOSH [1989]. Five family members die after entering manure waste pit on dairy farm. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 89–46.

NIOSH [1998]. 9-year-old child helping with blueberry harvest dies after being run over by cargo truck on field road. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98–15.

NIOSH [2000]. Sixteen-year-old farm worker dies in a cotton packing machine after being covered with a load of cotton—Georgia. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000–06.

NIOSH [2000]. A 15-year-old male farm laborer dies after the tractor he was operating overturned into a manure pit—Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000–18.

NIOSH [2002]. Youth farm worker dies after falling into operating feed grinder/mixer—Ohio. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2002–10.
29 State-based investigations of child agricultural deaths are available at: http://www.cdc.gov/niosh/injury/traumayouthface.html.

**Conference Reports and Papers**

Goldcamp EM, Hendricks KJ, Myers JR [2002]. Farm fatalities to youth 1995–1997: a comparison by age groups. National Institute for Farm Safety 2002 Annual Meeting, June 23–27, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2003]. Non-fatal injuries: an overview of injuries to youth on racial minority operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22–26, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2004]. Nonfatal all-terrain vehicle injuries to youth on farms in the U.S., 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20–24, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Hard DL [2000]. Special Session Moderator–Childhood Agricultural Injury Prevention. National Occupational Injury Research Symposium, October 17, Pittsburgh, PA.

Hendricks KJ, Adekoya N [2001]. Non-fatal animal-related injuries to youth occurring on farms in the United States, 1998. National Institute for Farm Safety Annual Meeting, June 24–27, Pittsburgh, PA. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Goldcamp EM, Myers JR [2002]. Fatal and non-fatal falls in United States agricultural production for youth less than 20 years old. National Institute for Farm Safety 2002 Annual Meeting, June 23–27, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Myers JR, Goldcamp EM, Layne LA [2003]. Farm hazards to household youth on minority operated farms in the United States, 2000: exposures and injuries from work, horses, ATVs and tractors. National Institute for Farm Safety 2003 Annual Meeting, June 22–26, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR [2004]. Injuries among youth on farms in the United States, 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20–24, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Layne LA, Myers JR, Hendricks KJ, Goldcamp EM [2003]. Demographics and non-fatal injury patterns of youth less than 20 years of age on Hispanic operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22–26, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Layne LA [2006]. Youth Living on Hispanic Operated Farms in the United States: An Examination of Population Growth and Changes in Risk Exposure and Injury Patterns between 2000 and 2003. National Institute for Farm Safety 2006 Annual Meeting, June 25–29, Sheboygan, Wisconsin. Columbia, MO: National Institute for Farm Safety.

Lee B, Gallagher S, Marlenga B, Hard D, eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic. *NIOSH was heavily involved in this summit meeting, due to the request of the summit organizers and because it was a cooperative agreement. In recognition of his input and involvement, Dr. Hard was invited to be an author of the final summit report.*

NCCAIP [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center. *As chair of the Research work group of the NCCAIP, Dr. Hard had input into the development of the recommendations and had the responsibility of generating the research recommendations for the NAP.*

Waters T [1998]. Children in Agriculture: Ergonomic Issues. Paper presented at the North American Guidelines for Children in Agriculture symposium, March 15–18, New Orleans, LA.

**Presentations**

Adekoya N, Myers JR [1999]. Farm and work injuries among youth 16-19 years of age, 1982-1994. Thirteenth Annual Childhood Injury Prevention Conference, October 25–27, San Diego, CA.

Hard DL [2003]. Agricultural Injury Surveillance Conducted by NIOSH. Presented at the 5th International Symposium: future of Rural People—Rural Economy Health People, Environment, and Rural Communities, October 19–22, Saskatoon, Saskatchewan, Canada.

Hard DL [2003]. The NIOSH childhood agricultural injury prevention initiative. National Occupational Injury Research Symposium, October 28–29, Pittsburgh, PA.
Hard D, Castillo D, Myers J, Pizatella T, Olenchock S [2000]. Overview of the NIOSH childhood agriculture injury prevention initiative. National Occupational Injury Research Symposium, October 17–19, Pittsburgh, PA.

Hard DL, Layne LA [1995]. A National Sample of Nonfatal Occupational Injuries Incurred by Youth Presenting to Hospital Emergency Departments: Agriculture Compared to Other Industries. Poster presentation at the Child and Adolescent Rural Injury Control Conference, March 8–9, Marshfield, WI.

Hendricks KJ, Myers JR, Adekoya N [2000]. Non-fatal childhood agricultural injuries in the U.S.–1998. Agricultural Safety and Health in a New Century, April 28–30, Cooperstown, NY.

Myers JR, Hendricks K [2000]. NIOSH approach to childhood agricultural injury surveillance. Agricultural Safety and Health in a New Century, April 28–30, Cooperstown, NY.

Myers JR, Hendricks K [2000]. NIOSH approach to childhood agricultural injury surveillance. Presented at the National Occupational Injury Research Symposium (NOIRS), October 17–19, Pittsburgh, PA.

Myers JR, Adekoya N [2000]. Fatal on-farm Injuries to Youth 16 to 19 years of age: 1982-1994 (poster). National Institute for Farm Safety 2000 Conference, June 25–29, Dubuque, IO.

Myers JR [2001]. Building Partnerships to Improve Rural Safety and Health. CSTE/APHL Annual Conference, June 10–14, Portland, OR.

Waters TR [2003]. Two-dimensional biomechanical modeling for estimating strength of youth and adolescents for manual material handling tasks. Poster presented at 2003 Challenges in Agricultural Health and Safety Conference, September 7–9, San Francisco, CA.

**Web Sites**

FACE Youth Fatalities [http://www.cdc.gov/niosh/injury/traumayouthface.html]

NIOSH Childhood Agricultural Injury Prevention Initiative [http://www.cdc.gov/niosh/childag/]

NIOSH Youth Injury [http://www.cdc.gov/niosh/topics/youth/]

### 4.5b Minority Populations

**Hired Farmworkers:**

**Publications**

Cameron L, Lalich N, Bauer S, Booker V, Bogue HO, Samuels S, Steege AL [2006]. Occupational Health Survey of Farm Workers by Camp Health Aides. J Agric Safety and Health, 2006; 12(2):139-153.

Estill C, Steege A, Baron S [2002]. Research and Dissemination Needs for Ergonomics in Agriculture. Public Health Reports 2002;117: 440-445.

Lee K, Lawson RJ, Olenchock SA, Vallyathan V, Southard RJ, Thorne PS, Saiki C, Schenker MB [2004]. Personal Exposures to Inorganic and Organic Dust in Manual Harvest of California Citrus and Table Grapes. J Occupat Environ Hyg 2004; 1:505-514. (ISI Web of Science: Cited 2 times as of 11/17/06)

**Posters**

"Health surveillance of hired farm worker women from the National Agricultural Workers' Survey." North American Congress of Epidemiology, June 2006, Seattle, WA.

**Presentations**

Presentations have been made at the North American Congress of Epidemiology, American Public health Association (APHA), at Agricultural meetings, and Migrant stream forums.

"The Occupational Health and Injury Experience of US Farmworkers," 15th Annual East Coast Migrant Stream Forum (Savannah Georgia, October 26, 2002).

"Vulnerabilidad de la Fuerza Laboral Hispana del Sector Agrícola en las Américas: Agricultores en los Estados Unidos y Modelos de Intervención," Hispanic Forum at the National Safety Council Congress & Expo (San Diego California, October 7, 2002).

"Pesticide Illness among Farmworkers in the United States and California," International Conference on Pesticide Exposure and Health. (Bethesda Maryland, July 9, 2002).

"A National Portrait of Farmworker Occupational Health in the United States," 14th Annual East Coast Migrant Stream Forum: *Asegurando Un Futuro Sano*. (Asheville North Carolina, October 27, 2001).

"Social and Economic Impacts of Globalization: Case Study of Agricultural Workers in the U.S.," 129th Annual Meeting of the American Public Health Association (Atlanta Georgia, October 22, 2001).

"Occupational Health Data from the NAWS: An Inter-Agency Collaboration," Migrant Interagency Meeting U.S. Department of Labor (Washington DC, October 10, 2001).

"The Health Supplement of the National Agricultural Workers Survey," 13th Annual East Coast Migrant Stream Forum: Joining Forces to Eliminate Disparities. (Philadelphia Pennsylvania, November 4, 2000).

"The Health Supplement of the National Agricultural Workers Survey," Midwest Farmworker Stream Forum *Las Raices de Salud*: Planting Care, Growing Wellness, Reaping Health. (Albuquerque New Mexico, October 27, 2000).

"The Health Supplement of the National Agricultural Workers Survey," 10th Annual Western Migrant Stream Forum. (Portland Oregon, February 3, 2001).

"Occupational Health Surveillance of Hired Farmworkers," Agricultural Safety and Health in a New Century. (Cooperstown New York, April 29, 2000).

"Occupational Health of Hired Farmworkers," State of the State: NC Farmworker Health Conference (Chapel Hill North Carolina, March 31, 2000).

"NAWS Occupational Health Supplement," 1999 Midwest Farmworker Stream Forum (Austin Texas, December 2, 1999).

*"*Challenges of Conducting Occupational Health Surveillance on a Special Population: Migrant Farmworkers" 1999 Annual Meeting of the American Public Health Association (Chicago Illinois, November 8, 1999).

"Worker to Worker: Collecting Occupational Health Data on Farmworkers through Camp Health Aides." National Association of Community Health Centers National Migrant Health Meeting (Denver Colorado, April 24, 1999).

"Worker to Worker: Collecting Occupational Health Data on Farmworkers through Camp Health Aides." Western Farmworker Stream Forum (Sacramento California, January 29, 1999).

"Farmworker Health and Safety in the 90's." 1993 National Farmworker Conference (San Diego, California, February 25, 1993).

"Introduction to NIOSH Agricultural Program." Midwest Farmworker Stream Forum (San Antonio, Texas, November 6, 1998).

"Opening Doors to Increasing Migrant Health Research." Midwest Farmworker Stream Forum (Albuquerque, New Mexico, October 26 and 27, 2000).

"Forum Research Track: Opening Doors to Increasing Migrant Health Research" National Center for Farmworker Health Workshop (Atlanta, Georgia, February 15, 2001).

"Farmworker Forum Research Track: Participation and Rewards" National Center for Farmworker Health Workshop (Atlanta, Georgia, February 16, 2001).

"Introduction to the Research Track for the Stream Forum." Midwest Farmworker Stream Forum (New Orleans, Louisiana, November 20, 2002).

"A National Perspective on Agricultural Safety and Health." Migrant and Immigrant Health in Rural Pennsylvania: Putting Migrant Farmworkers First (State College, Pennsylvania, September 26, 2003.

## Farm Operators

### Manuscript

Ethnic, Racial, and Gender Variations in Health among Farm Operators in the United States. Undergoing revision and clearance for submission to the Annals of Epidemiology.

### Posters

Mental Health Symptoms in a Population Based Survey of Minority Farm Operators. American Public Health Association Annual Meeting. San Francisco, CA, November 2003.

Minority and Female Farm Operator Occupational Health Survey," 130th Annual Meeting of the American Public Health Association (Philadelphia Pennsylvania, November 12, 2002).

Occupational Hearing Loss in a Population Based Survey of Minority Farm Operators. American Public Health Association Annual Meeting. San Francisco, CA, November 2003

### Presentations

Minority Farm Operator Occupational Health, Black Farmers and Agriculturalists Association Meeting. (Atlanta Georgia, February 8-10, 2002).

Steege, A, Alterman T, Sestito, J, Baron S, Estill C, Lalich N, Cameron L [2000]. Occupational Health Surveillance of Hired Farm workers. Agricultural Safety and Health in a New Century, Cooperstown, NY April.

## 4.5c Logging

### Publications

Bell JL [2002]. Changes in logging injury rates associated with the use of feller bunchers in West Virginia. J Safety Res *33*:463–471. (ISI Web of Science: Cited 3 times as of 11/20/06)

Bell JL, Grushecky ST [2006]. Evaluating the effectiveness of a logger safety training program. J Safety Res *37*:53–61.

Bell JL, Helmkamp JC [2003]. Non-fatal injuries in the West Virginia logging industry: using workers' compensation claims to assess risk from 1995 through 2001. Am J Ind Med *44*(5):502–509. (ISI Web of Science: Cited 5 times as of 11/20/06)

Centers for Disease Control and Prevention [1994]. Risk for traumatic injuries from helicopter crashes during logging operations—Southeastern Alaska, January 1992–June 1993. MMWR 43(26):472–475.

Fosbroke DE, JR Myers [1996]. Logging safety and forest management education: a necessary link. J Forestry *94*(7):21–25.
Myers JR, Fosbroke DE [1995]. The Occupational Safety and Health Administration logging standard: what it means for forest managers. J Forestry *93*(11):34–37. (ISI Web of Science: Cited 5 times as of 11/20/06)

Helmkamp JC, Bell JL, Lundstrom WJ, Ramprasad J, Haque A [2004]. Assessing safety awareness and knowledge and behavioral change among West Virginia loggers. Inj Prev *10*:233–238. (ISI Web of Science: Cited 1 time as of 11/20/06)
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### 4.5d Fishing

#### Databases (Surveillance)

Alaska Occupational Injury Surveillance System, 1990-2006 (Created and maintained by NIOSH AFS).

Alaska Trauma Registry, 1991-2006 (NIOSH funded since 1993).

#### Patents

"Electro Hydraulic Emergency Stop Device for a Winch", Invention Report submitted Nov. 2005, Centers for Disease Control reference #I-008-06.

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National Fishing Industry Safety and Health Workshop, Anchorage, AK: October 9-11, 1992.
National Fishing Industry Safety and Health Workshop, Seattle, WA: November 21-22, 1997.
International Fishing Industry Safety and Health Conference, Woods Hole, MA: October 23-25, 2000.
International Fishing Industry Safety and Health Conference, Sitka, AK: September 22-24, 2003.
International Fishing Industry Safety and Health Conference, Chennai, India: February 1-4, 2006.

**Recommendations from the NIOSH CIB**

- A requirement for periodic stability reassessment and vessel inspection of all vessels should be seriously considered, as equipping and retrofitting can substantially affect the stability of vessels.

- Minimum specifications for watertight components and bulkheads sufficient to keep swamped or capsized vessels afloat should also be developed, implemented, and evaluated.
- A thorough assessment should be made of current training requirements and efforts, and deficiencies should be immediately corrected.
- Consideration should be given to establishing adequate watch-keeping and staffing requirements for all vessels.
- Consideration should be given to requiring the successful completion of basic fishing safety training, such as those programs currently offered by the AMSEA, before an Alaskan (State) crew license or a commercial fishing permit is issued.
- All current and proposed management regimes should be examined from a safety and health perspective.
- Weather information should be more closely heeded.
- All fishermen should wear PFDs when on the deck of any vessel.
- MOB alarms should be thoroughly evaluated and widely deployed if such evaluations demonstrate that the devices are effective.
- Thorough study of the handling of lines, especially during deployment of crab pots, should be conducted to reduce worker exposure to this hazard.
- A training curriculum should be developed, implemented, and evaluated for fishermen who are harvesting seafood or clearing lines or nets by diving.

**Web Sites (NIOSH)**

FACE Fishing Page: http://www.cdc.gov/niosh/injury/traumafishface.html

Fishing Topic Page: http://www.cdc.gov/niosh/injury/traumafish.html

**Miscellaneous**

The AFF Program provided technical assistance, and contributed text for the publication of "Deck Safety for Crab Fishermen" published by Jensen Maritime Consultants: Seattle, WA 2002.
We consulted on the publication of "Lobstering Safety Secrets Revealed!" produced by Harvard/NIOSH Education and Research Center for Occupational Safety and Health: Boston, MA 2000.

Commercial fishing deck safety models built by Jensen Maritime Consultants illustrating deck safety improvements and falls overboard avoidance interventions.

E-switch model developed by AFF Program engineers to illustrate the emergency shut off switch designed to be used on capstan style deck winches.

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