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Occupational accidents in Japanese forestry, 1970-2020

By

Yuki IMATOMI*

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Summary：The author's viewpoint is that, for forest workers, the minimal working environment consists of a safe workplace and the fewest possible accidents. The purpose of this study is to investigate the state of forestry occupational accidents in Japan while assessing the history and current state of occupational accidents in the forestry industry, and to propose strategies and directions for the prevention of future accidents. The author analyzed forestry occupational accidents in Japan over the past 50 years. In this study, the author analyzed patterns of casualties and deaths caused by occupational accidents in the forest industry, and compared occupational accidents with those seen in other industries, work-type accidents, and the relationship between worker attributes and accidents. The results showed a decrease in the number of casualties due to accidents in the forest industry over the long term, but reveal that this decrease is due to a decline in forestry production work such as logging, planting, weeding, and thinning. The author compared the incidence rate of accidents with that of other industries. Since 1987, this index has remained unchanged, but that for forestry work shows the highest value. In 2019, the incidence rate was 20.8 for forestry, about 9.5 times the average for all industries. The most frequent and serious accidents occurred during felling. It appears that the adoption of large-scale and advanced mechanical processors, harvesters, etc., for various logging-related operations has led to fewer accidents. The total number of accidents was highest among workers aged 60 and over. On dividing the labor force into individual age groups, however, it appears that the youngest age group (under 19 years old) is the most vulnerable.

Key words：forest work, accidents, accident statistics, Japanese forestry

Introduction

Since the Second World War, Japan's growing stock of forests has been enriched and expanded through forestry management activities in planted forests. The process has now shifted to the utilization stage[1]. The current task facing the Japanese forestry industry is to promote reforestation while utilizing forest resources. It is therefore crucial to increase employment in mountain villages by making forestry a worthwhile form of employment. For forestry workers, job safety is the most basic requirement. This prompted the author to conduct a research study to clarify the situation of forestry occupational accidents in Japan while investigating the history and current rate of occupational accidents in the forest industry, and to propose strategies and future directions for accident prevention via an analysis of the data over the past 50 years. The author has conducted an analysis of the current situation and published reports on forestry occupational accidents in Japan[2, 3]. In this study, the author carried out an analysis of past changes in, and the current rate of, forestry occupational accidents in Japan over a long span of about half a century, as well as an investigation, from a quantitative perspective, of the relationship between labor force numbers and forestry production as a function of the increases and decreases in occupational accidents.

Method

In this study, the author analyzed forestry occupational accidents in Japan over the past 50 years based on accident statistics and forestry labor force numbers, and via a questionnaire survey that conducted on the relationship between forestry work experience and labor accident

* Faculty of Regional Environmental Science, Department of Forest Science

occurrence, in order to clarify the related influential factors. For forestry occupational accidents, the Ministry of Health, Labor and Welfare reported on worker deaths and injuries, worker accident compensation insurance, and occupational accident statistics. For the forestry labor force, the national censuses were used. Since occupational accidents are related to production activities, a Forestry Agency survey on timber harvesting volumes and planted areas for reforestation was utilized.

Results and discussion

History of forestry occupational accidents

The simplest indicator of the occurrence of occupational accidents is the number of accidents recorded. Materials that shed light on the number of occurrences include legal statistics, such as worker death and injury reports, and insurance information such as workers' accident compensation insurance statistics, which have been collected in Japan since 1973[4]. Figure 1 shows the number of accidents (4 days or more lost work days) in the forestry industry over the past 50 years (from 1970 to 2020). The number of accidents in 1970 was 16,248, but by 2020 it was estimated at 1,275. The rate of decrease was rapid until around 1990, after which it decreased more gradually. The number of deaths decreased sharply from 1970 to 1980, and has been on a downward trend since then, with a slight decline to a steady level since 2000.

Figure 2 shows the number of casualties and deaths from 2000 to 2020. The number of accidents shows a decline. The number of deaths fluctuated greatly in the range of about 40–60 until 2010, but has remained almost flat in the range of 30–40 since then. Setting the number of accidents in the forestry industry in 1970 at 100%, the figure for 1980 was 76.3%, 1990 : 31.2%, 2000 : 19.0%, 2010 : 14.5%, and 2020 : 7.8%. The percentage of accidents due to the above is calculated to have decreased by more than 90% over the last 50 years. Although the number of accidents in the forestry industry has decreased significantly over this time, there is no real feeling that forestry labor has become safer, possibly because both the labor force and production activities in the forestry industry have decreased significantly.

Figure 3 shows the volume of timber harvested and the number of forestry workers every five years from 1970–2015[5, 6]. The volume of timber harvested in 1970 was 49,780,000 m^3, but it had decreased to 24,918,000 m^3 in 2015. The number of forestry workers was 206,033 in 1970, but it had fallen to 63,663 in 2015. Both totals have

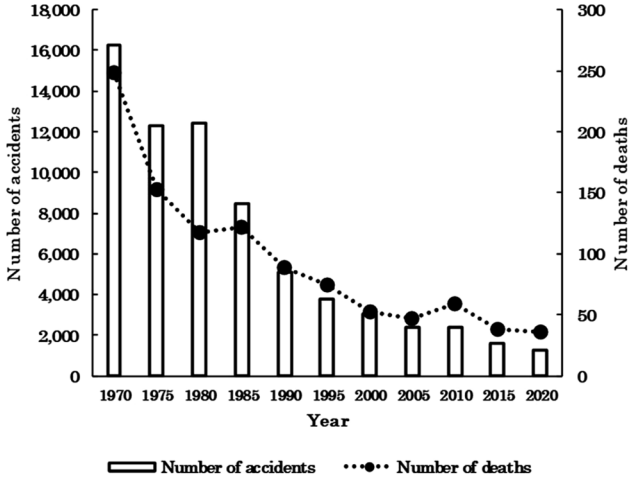

Fig. 1 History of forestry labor accidents

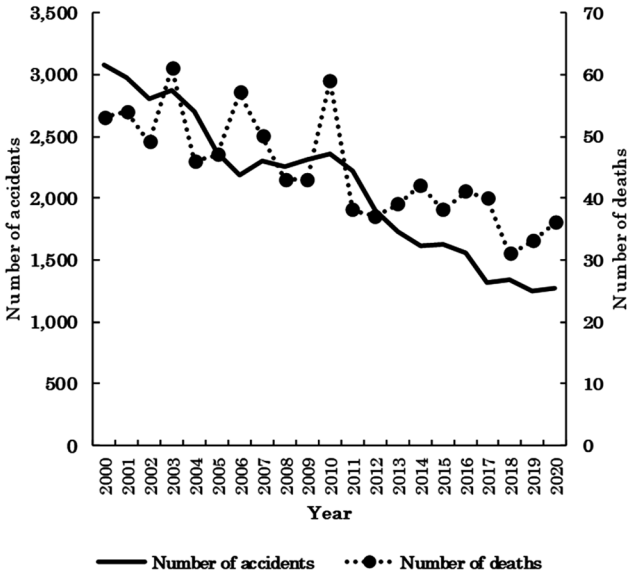

Fig. 2 Forestry labor accidents and deaths from 2000–2020

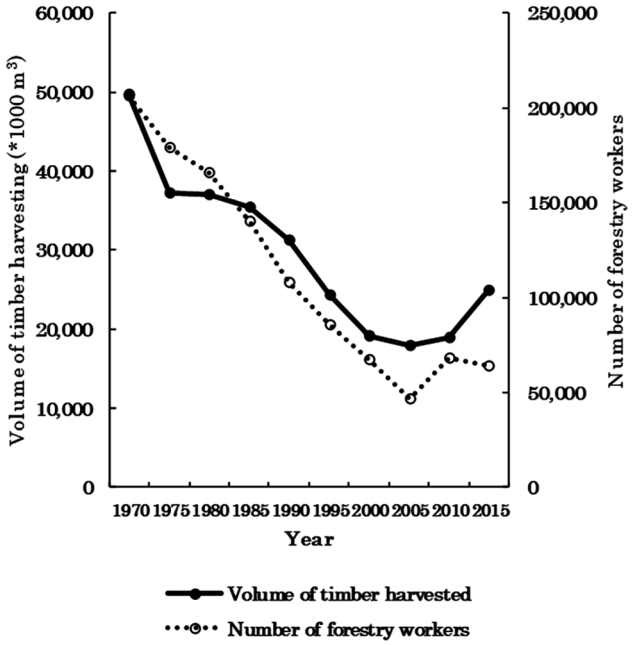

Fig. 3 Changes in volume of timber harvesting and numbers of forestry workers

decreased significantly. Figures 4 and 5 showed the volume of timber harvested and forestry workers, and forestry workers and casualties every five years for the period from 1970–2015. A positive correlation was found between the volume of timber harvested and the number of forestry workers, and between the number of forestry workers and the number of accidents. If we regard the volume of timber harvested and the number of forestry workers as indicators of production activities and labor force, respectively, the decrease in accidents in forestry from a long-term perspective is simply the result of a decrease in the labor force due to a decline in production.

Comparison of occupational accidents between forestry and other industries

To enable a comparison of occupational accidents between industries, indicators such as incidence rate, frequency rate, and severity rate are used here as an evaluation scale based on relative values rather than the absolute number of occurrences. The incidence rate is the number of accidents per 1,000 workers, the frequency rate is the number of accidents per million working hours, and the severity rate is the number of lost workdays per million working hours. These indicators are calculated according to the following formula.

$$\text{Incidence rate} = \frac{\text{total number of accidents} \times 1{,}000}{\text{total number of workers}}$$

$$\text{Frequency rate} = \frac{\text{number of accidents} \times 1{,}000{,}000}{\text{total number of working hours}}$$

$$\text{Injury severity rate} = \frac{\text{total lost workdays} \times 1{,}000{,}000}{\text{total number of working hours}}$$

In this study, a comparison with other industries was made using incidence rate as an index.

Figure 6 shows the incidence rate from 1970–2019. In 2019, the incidence rate was 20.8 for forestry and 2.2 for all industries. The forestry sector is equivalent to about 9.5 times the average for all industries, making it the highest in the industrial sector. Until 1986, the mining sector had the highest average among industrial sectors, but since 1987, the forestry sector has been the highest. This index has been on a downward trend in industries other than forestry. The forestry sector was on a downward trend until around 1990, but has remained almost flat since then. The forestry sector therefore has the highest frequency of industrial accidents, and is thus regarded as being the most dangerous of all industries. As mentioned above, the number of forestry-related deaths

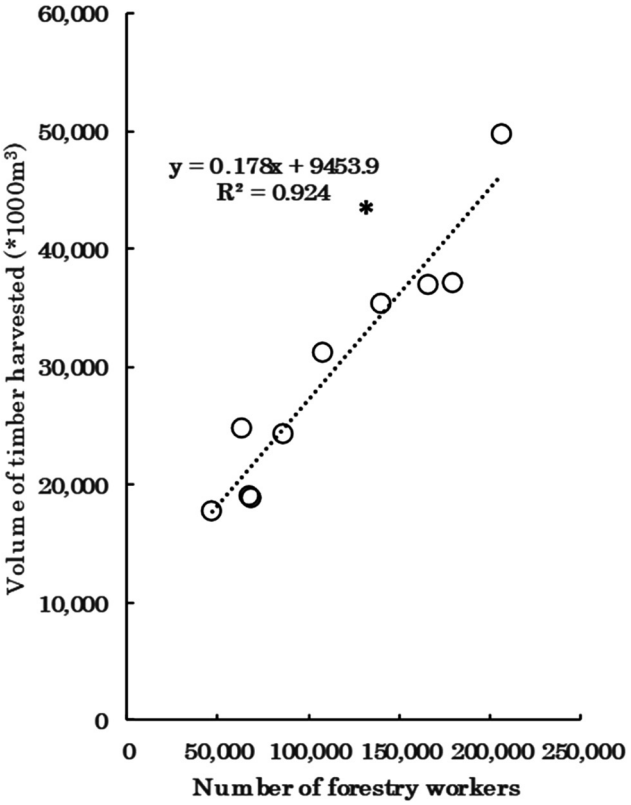

Fig. 4 Relationship between number of forestry workers and volume of timber harvested
*indicates statistical significance at the 1% level

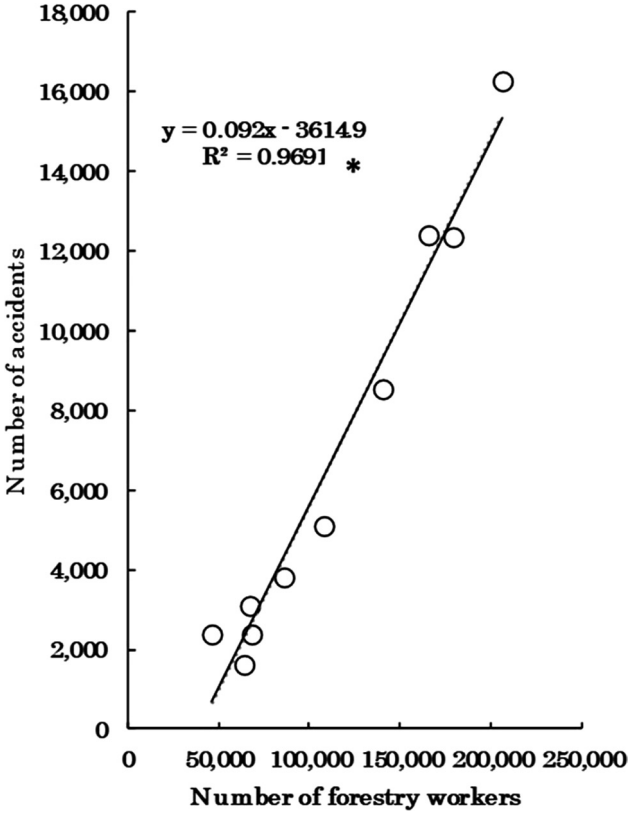

Fig. 5 Relationship between number of forestry workers and number of accidents
*indicates statistical significance at the 1% level

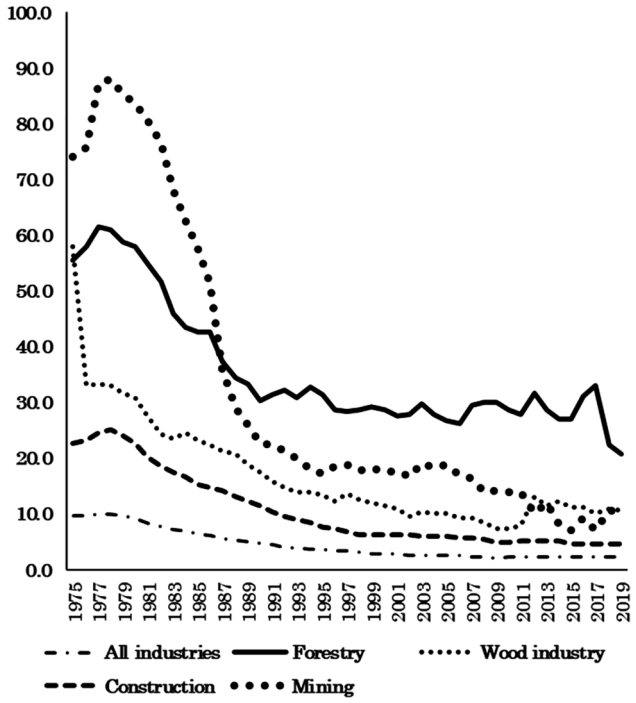

Fig. 6 Changes in incidence rate

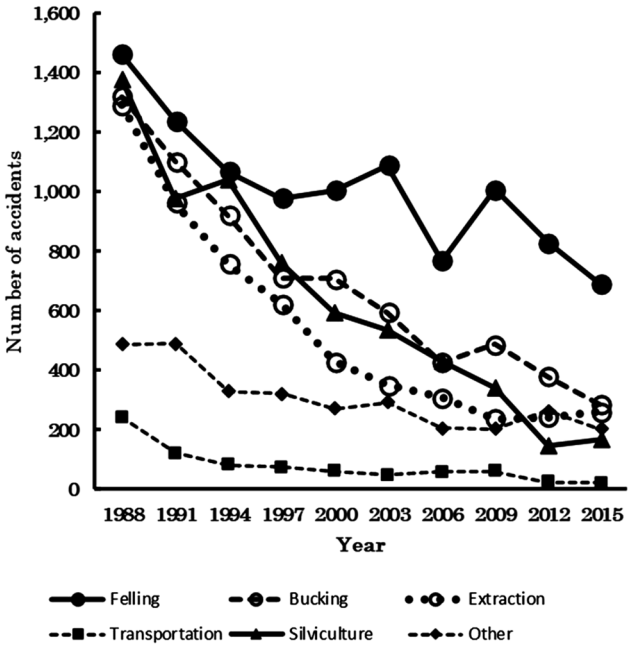

Fig. 7 Changes in number of accidents by forestry task

has been flat in recent years. The author calculated the number of deaths per 1,000 workers based on the number of employees by industry and the number of fatal accidents by industry in 2015[7, 8]. As a result, the highest value in forestry was 0.5972, followed by construction at 0.0651. It was 0.0152 for all industries. The number of deaths per 1,000 workers in the forestry industry is therefore 39.2 times that of all industries and 9.2 times that of the construction industry.

Number of occupational accidents that occurred for each type of work

Figure 7 shows changes in the number of accidents that occurred for each type work from 1988–2015. The number for logging is the total number of accidents that occurred during cableway transport, yarding, skidding and forwarding, and piling. The number in silvicultural work is the total number of accidents that occurred during ground preparation, planting and weeding. It has been on a downward trend for all operations. In 1985, the number of accidents in silvicultural work was the highest, and it can be seen that many accidents have historically occurred in silvicultural work. On the other hand, in the latest figures (2015), the value for silvicultural work is the lowest. The number of accidents occurring in silvicultural work decreased sharply until the early 1990s, and has decreased gradually since then. According to the 1988 data[9, 10], the number of accidents in silvicultural work was 1,376, of which the breakdown was ground preparation : 255, planting : 49, weeding : 861, and others : 211. The accident ratios are 18.5%, 3.6%, 62.6%, and 15.3%, respectively. Since a brush cutter is used in addition to hand tools such as sickles for ground preparation and weeding, it can be confirmed that there is a high risk of injury leading to leave of absence.

The number of accidents occurring in operations related to logging work (felling, bucking, extraction) is felling＞bucking＞extraction, with the number of accidents during felling work being the highest. A decrease was observed at a certain rate from 1985–1994, but it has been declining gradually since 1994. It can be seen that accidents during bucking and extraction have decreased over the period shown in the Figure.

According to an analysis of accident reports for forestry labor[11], fatal accidents that occurred during felling from 2001–2014 accounted for 57% of total work accidents. It is thus evident that felling is a task during which serious accidents most frequently occur.

Figure 8 shows changes in the number of forestry machines owned and the number of accidents per 10,000 m^3 of timber harvested for each logging-related task. The number of forestry machines owned for felling comprises the total number of feller bunchers and harvesters ; the number for bucking is the number of processors ; and the number of forestry machines for extraction work includes skidders, forwarders, tower yarders and swing yarders. In Japan, harvesters are often used as a substitute for processors. With felling, there is no relationship between the number of forestry machines owned and the number of accidents per unit of timber harvested. For bucking and extraction, the number of accidents per unit

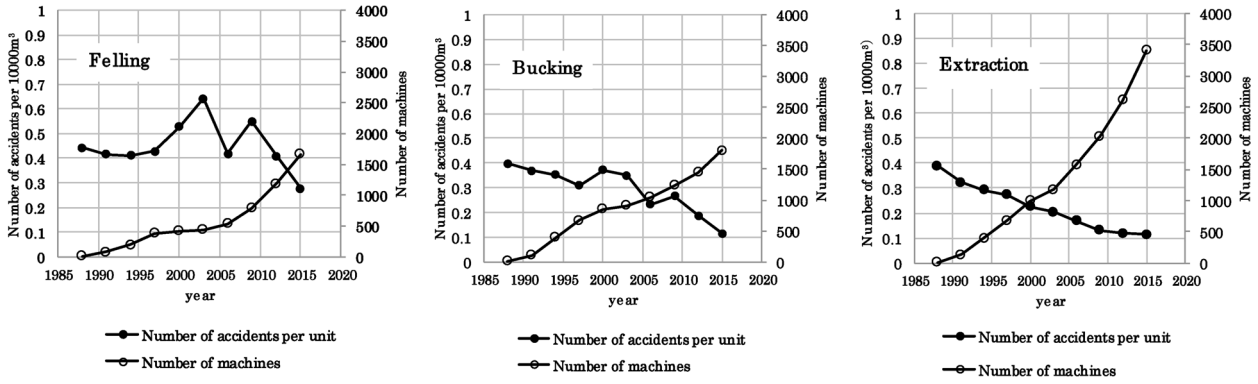

Fig. 8 Changes in the number of machines owned and the number of accidents per unit production volume used in each work process

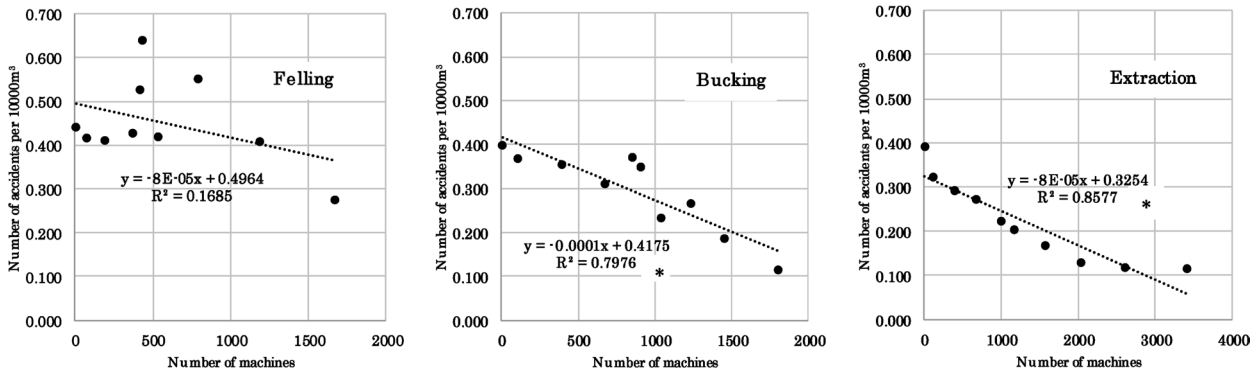

Fig. 9 Relationship between the number of machines used in each work process and the number of accidents per unit production
*indicates statistical significance at the 1% level

production tends to decrease as the number of forestry machines owned increases. The relationship between the two is seen more clearly in extraction work.

Figure 9 shows the relationship between the number of forestry machines owned for each task and the number of accidents per unit of timber harvesting volume (Number of accidents per 10,000 m^3). In felling, no relationship was found between both, whereas in bucking and in extraction, a negative correlation was found. It is therefore evident that accidents will decrease as ownership of forestry machinery for bucking and extraction increases, likely due to the growing sophistication of these machines. Bucking was previously performed with chainsaws, but it can be said that the mechanization of this work has progressed due to the use of processors. In extraction as well, there has been a shift from working with yarders to the use of vehicles such as forwarders and small trucks, which have lower risk of accidents. On the other hand, for felling, large machines such as feller bunchers and harvesters have been adopted and utilized. However, due to the topographical conditions of forest areas in Japan, it is difficult for wheeled traveling machines of this type to move around. It therefore appears that the reason for the lack of reduction of felling accidents is that this job is still mainly carried out using chainsaws.

Relationship between occupational accidents and worker attributes

To clarify the relationship between occupational accidents and the attributes of workers, the author categorized the changes in the number of accidents by age group, incident rates by age group, and the relationship between forestry work experience and occupational accidents. Figure 10 shows changes in the composition ratio of accidents by age group.

The age groups with the highest proportion of accidents were over 60 years＞50s＞30s and 40s＞20s＞under 19 years. The older the age group, the higher the accident composition ratio. In other words, it can be understood that the fatalities and injuries caused by occupational accidents occur mostly in the elderly rather than in the young. Looking at the changes by year, accidents in the age group of 20–29 years old and 60 years old and over remained unchanged, the age group of 50–59 years decreased slightly, and the age group of 30–39 years and 40–49 years increased slightly. There was a tendency

for accidents in the group under the age of 19 to increase slightly. Since the number of workers in each age group is different, this study examined the number of casualties per 1,000 workers by age group. Figure 11 shows the result. What both years have in common is that the accident rate in the under 19 age group is considerably higher than that of the other age groups. It also seems that the value gradually decreases with increasing age, but the pattern is far from clear. Most accidents occur in the elderly over 60 years old, but considering the number of employees in each group, it is clear that the risk of occurrence is high in the youngest age group (under 19 years). This is a similar result to that shown in a previous report[12].

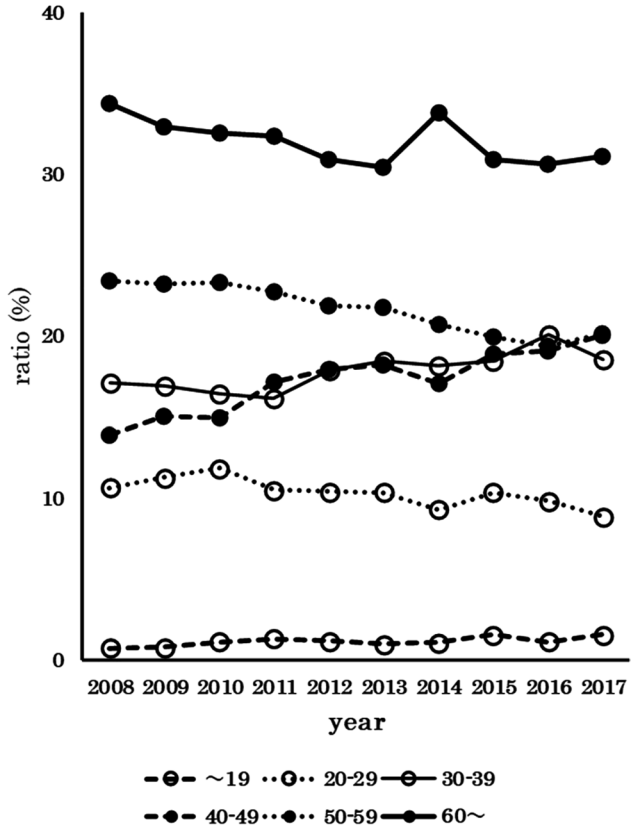

Fig. 10 Changes in the number of accidents by age group

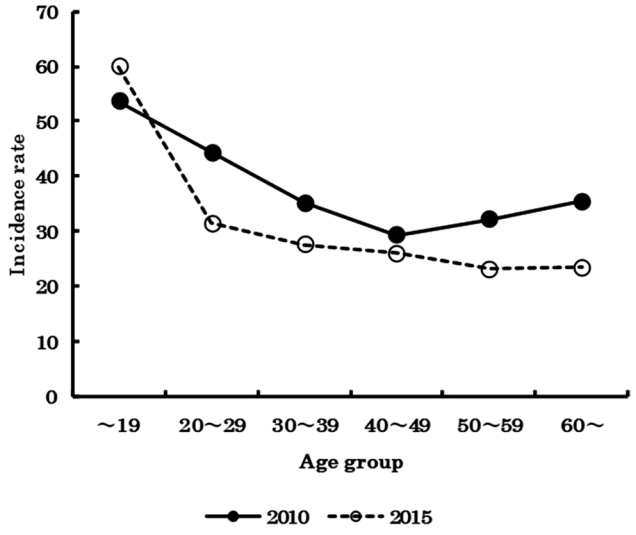

Fig. 11 Incidence rate by age group

The relationship between employees' work experience and accidents has also been reported[2]. According to the report, inexperience leads to a higher accident rate ; the rate of accidents decreases with increasing number of years of experience ; and workers with more than 10 years of experience tend to be assigned to logging work. On the other hand, workers with less than three years of experience report that they are often assigned to silviculture work. It appears that forestry enterprise managers are more likely to assign inexperienced workers to silvicultural operations rather than logging operations, which are technically difficult and carry a high risk.

Conclusion

The results of this study can be summarized as follows.

(1) The occurrence of occupational accidents in Japan's forestry industry has been declining for five decades. It decreased sharply from 1970– to 1990, and has been on a gradual decrease since then.

(2) The number of deaths decreased sharply from 1970–1980, and has been on a downward trend since then, but has been flattening out since 2000.

(3) Although the occurrence of occupational accidents is decreasing, the incidence rate is far higher than in other industries.

(4) It was found that the occurrence of occupational accidents is proportional to forestry production activities and the size of the labor force, and that the decrease in accidents over a long period is caused by the decline in forestry production leading to a shrinking labor force.

(5) In the past, accidents occurred most often in silvicultural work, but now they occur most frequently in felling, followed by bucking, extraction, and silvicultural work.

(6) Felling is mainly done with chainsaws. The lack of advanced machines that can tolerate Japan's often steep forest terrain is slowing the further reduction of accidents.

(7) The number of accidents in bucking and extraction has decreased, likely due to the increasing sophistication of forestry machines.

(8) There are many occupational accidents in the elderly (60 years old and over). This is thought to be due to the large number of workers in this age group. An examination of the index that takes into account the size of the labor force in each age group reveals the

youngest age group (under 19 years) to be proportionally more likely to be affected by accidents.

(9) Many accidents occurred to people with little forestry work experience.

Based on the results of this analysis, the ideas and directions for future accident prevention are as follows.

- Although the number of casualties due to forestry accidents is decreasing, the incidence of accidents and the number of deaths is higher than seen in other industries. It is therefore crucial to continue to work on various strategies for reducing accidents and to devise measures to prevent serious accidents.
- The highest proportion of accidents occurs during felling. It is therefore necessary to urgently promote accident prevention during felling. Specifically, the conversion to more sophisticated machines (large machines with cabs) can be proposed as an improvement measure. It is also necessary to improve felling techniques using chainsaws by education and training, and to implement education and training using different methods.
- It is necessary to improve forest work skills through education and training for young workers.
- Extra care is needed for older workers to prevent accidents. Specific examples include making them more aware of the deterioration of physical function with age and a review of how work is allocated.

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1970～2020 年におけるわが国の林業労働災害の分析

今　冨　裕　樹*

（令和 3 年 10 月 20 日受付/令和 4 年 1 月 21 日受理）

要約：著者は山林で働く労働者にとって災害の少ない安全な仕事であることが最も基本的な労働環境と考えている。そこで，これまでの林業における労働災害の推移・状況を確認しながら，わが国における林業労働災害の状況を明確にしつつ，今後の災害防止にあたっての考え方・方向性を提起することを本研究の目的として，過去 50 年にわたるわが国の林業労働災害の分析を行った。

本研究では林業での災害による死傷者数・死亡者数の推移，災害に関する産業間比較，作業種別災害，災害と労働者の属性について分析を行った。その結果，林業での災害による死傷者数は長いスパンでみると減少していることが示され，この減少は素材生産や植栽・下刈・間伐等の林業生産活動の低下に伴う労働力の減少に起因していることが確認された。死傷年千人率を使って他産業間の災害発生比較を行った。1987 年以降，本指標は林業が他産業に比較して最も高い値を示しながら今日まで推移していることが示された。2019 年（令和元年）の死傷年千人率は林業：20.8 であり全産業平均の約 9.5 倍に相当した。作業種別災害では，伐木において災害が最も多く発生していること，重篤な事故が多く発生していることが示された。伐採搬出に関する諸作業においては，プロセッサ，ハーベスタ等の大型で高度な機械化の活用が災害の減少につながっていることが推察された。災害と労働者の属性については，60　歳以上の高年齢層での災害発生数が多かった。年齢階ごとの労働力を加味すると，19 歳以下の若年齢層において被災する確率が高いことが示された。

キーワード：林業労働，災害，災害統計，日本林業

* 東京農業大学地域環境科学部森林総合科学科