Chapter

Legal and Administrative Aspects of Forest Pest and Disease Control in Japan

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Abstract

Approximately 40% of Japanese forests are softwood plantations consisting of trees such as Japanese cedar (*Cryptomeria japonica*), Japanese cypress (*Chamaecyparis obtusa*), and several varieties of pine (*Pinus* spp.). Policies and programs related to forest pests and diseases are important for growing forest plantations. Damage caused by the pine bark beetle (*Monochamus alternatus*) has been a long-standing problem in Japan. Forest damage caused by the pine bark beetle was first found in Nagasaki Prefecture in 1905. Since then, the area of damage has expanded gradually to all prefectures. Damage caused by pine bark beetles became serious during and just after the end of the Second World War. In 1950, the Natural Resource Section of the General Headquarters of the Allied Forces, Supreme Commander for the Allied Powers (GHQ/SCAP) made recommendations for how to control forest pests and diseases. The first act was enacted in 1950, although the control of forest pests was initially addressed as part of the first Forest Act of 1897. Several important reasons for why the Japanese government has failed to stop the expansion of the damaged area can be found in GHQ recommendations: the lack of coordinated programs, underutilization of damaged trees, and shortcomings of forest-management plans.

Keywords: cutting damaged trees, Forest Act, forest management plan, Forest Pest Control Act, GHQ, pine bark beetle, usage of damaged trees

1. Introduction

Measures to respond to natural disasters and various kinds of pests and diseases are necessary for sustainable forest management. There have been numerous natural disasters in Japan because of its steep terrain, abundant rainfall, and the susceptibility of its islands to typhoons. The area of damaged forests changes annually, with respective values, for example, of 7,023 ha, 4,831 ha, 5,686 ha, 14,575 ha, and 3,766 ha over the 5-year period from 2013 to 2017, respectively [1]. This constitutes a total area of 35,881 ha, equal to 26.7% of the total area of new forest planted during the same period (134,531 ha).

The area of forests damaged by pests and disease is significant, although it is difficult to measure the damaged area precisely due to the constant spread of damage over a long period. On the other hand, climate-related damage occurs over short periods. As a result, statistics on damaged forests sometimes use the volume of damaged trees instead of the area of damaged forests.

The most serious and long-term damage in Japan has been caused by the pine bark beetle [2]. The first pine bark beetle damage[1] was recorded around 1905 in Nagasaki Prefecture[2] on Kyushu Island, which is the western-most of Japan's four main islands [2]. Since then, the damaged region has gradually extended to the east. According to the most recent statistics, the volume of damage was 399,000 cubic meters in fiscal year 2017 [1], equivalent to 62.2% of the volume of pine production in the same year (641,000 cubic meters).

Sustainable forest management, especially in the case of coniferous plantation forests, necessitates protection against various kinds of damage, such as that from climate change, pests, disease, and forest fires.[3] Countermeasures to protect against damage include both technical and social actions, for example, forest-management systems, forest-product consumption, and legal systems of forest management. This chapter focuses on the legal and administrative aspects of social countermeasures.

The contents of this chapter are as follows. Section 2 discusses the method and statistical overview of damage caused by the pine bark beetle. Section 3 covers the development of the legal system and related topics. Section 4 explores the legal and administrative reasons why damage from the pine bark beetle has continued unabated over the last 100 years, in the context of the present-day GHQ recommendations. Concluding remarks are made in the final section.

2. Methods and overview of damage

2.1 Methods

Primary sources of information were literature surveys and statistical data from the Forestry Agency of the Ministry of Agriculture, Forestry, and Fisheries (MAFF). Information from the literature surveys was divided into three categories.

The first category is the Forest Act and related enforcement orders. The first Forest Act was enacted in 1897, with amendments in 1907, 1939, and 1951. In 1950, articles on pest and disease control were transferred from the Forest Act to a new act dealing only with pest and disease control.

The second category is the legal system. There have been several acts relating to the pine bark beetle.

The third category includes literature and documents from the Natural Resource Section (NRS) of the General Headquarters of the Allied Forces, Supreme Commander for the Allied Powers (GHQ/SCAP). In 1950 and 1951, GHQ made two recommendations on pine bark beetle management.

Most of the literature related to the first and second categories is owned by the Library of Forest Resources and Society, Graduate School of Agriculture, Kyoto University. Some was retrieved from the website of the Forestry Agency[4]. Documents by the NRS of the GHQ/SCAP were obtained from the digital collections of the National Diet Library and microfiche materials collected by the Modern Japanese Political History Materials Room of the National Diet Library. Most of the

[1] Pine bark beetle damage in the area currently known as Chiba Prefecture was recorded in 1804 (Edo Period) [3].

[2] According to the Forestry Agency [2], the first record was reported by Yano [4].

[3] The number of forest fires and the combined area of burned forest in fiscal year 2017 were 1,284 fires and 938 ha, respectively [1]. Generally, the damage caused by forest fires is not very large in Japan.

[4] https://www.rinya.maff.go.jp/j/kouhou/toukei/index.html, 2020/11/05

statistical data were obtained from the Annual Statistics of Forestry, edited by the Forestry Agency. Statistical data from and immediately after the Second World War were based on the former administrative organization of the Forestry Agency[5] and documents compiled by NRS of the GHQ/SCAP.

The essential Japanese literature defining pest control policies in Japan includes [5–8]. The relevant English literature, published during occupation, is limited to [9, 10]. These publications were used as sources for all explanations of policy and legislation covered in section 3.

English translation of the current Forest Pest Control Act (Act No. 53 of 1950), Order for Enforcement of the Forest Pest Control Act (Cabinet Order No.87 of 1997), Forest and Forestry Basic Act (Act No. 161 of 1964), was based on the Japanese Law Translation webpage[6] prepared by the Ministry of Justice, Government of Japan.

2.2 Statistics on pine plantation forest damage by the pine bark beetle

The volume of pine trees damaged by the pine bark beetle since 1932 is shown in **Figure 1**. The volume of national forest damage in 1956, 1957, and 1958 is unclear. The volume of forest damage was 670,000, 635,000, and 802,000 cubic meters in 1956, 1957, and 1958, respectively [3]. However, these amounts are larger than the total volume of damaged national and non-national forest shown in [7]; therefore, we have omitted national forest damage volume data for these three years. For 1948 and 1949, GHQ reports greater volumes of damaged forest than reported by the ministry [15]: 225,000 cubic meters for national forest and 1,267,000 cubic meters for non-national forest in 1948, and 192,000 cubic meters for national forest and 1,487,000 cubic meters for non-national forest in 1949.

There are two peaks in the volume of damage; the first occurred in 1948 and 1949, when the volume of damage was 1.3 million cubic meters. Subsequently, the volume tended to decrease. The annual volume of damage was almost 0.4 million cubic meters to 0.5 million cubic meters by 1971, after which time it increased again, reaching a second peak of 2.4 million cubic meters in 1979. The volume of damage was almost double that in the first peak year. Since the second peak year,

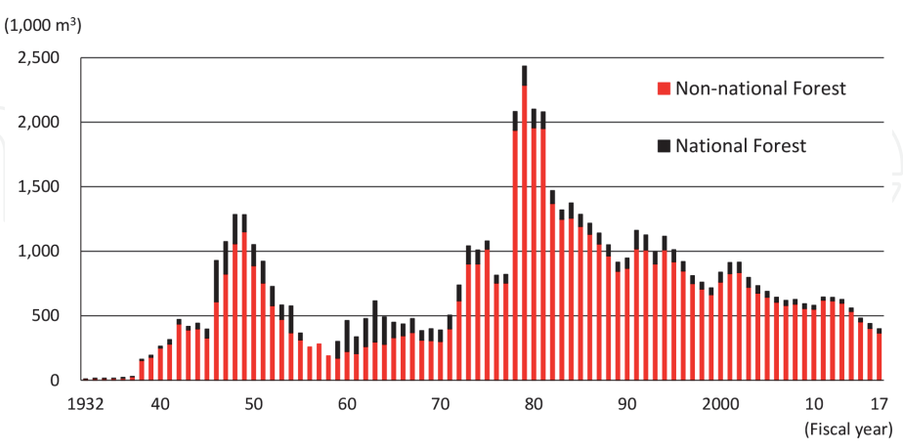

Figure 1.
Volume of forests damaged by pine bark beetles. Source: [3, 11–14]. Note: The Japanese forest classification system defines non-national forests to include private forests and public forests owned by prefectural governments, municipalities, etc.

[5] Before 1947, the national forest was managed by three ministries. One of the bureaus was the Bureau of Forest, Ministry of Agriculture and Forestry.

[6] http://www.japaneselawtranslation.go.jp, 2020/11/05

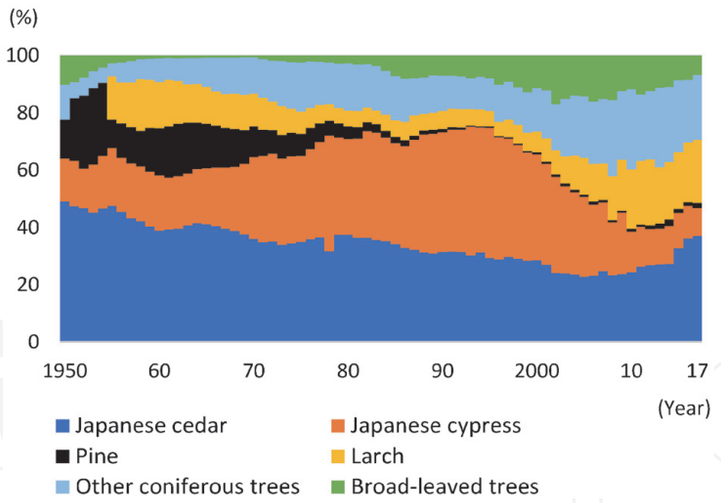

Figure 2.
Percentage of planted area classified by species. Source: [12–14, 16]. Note: Before 1954, pine include larch. After 1989, data include the area of underplanting.

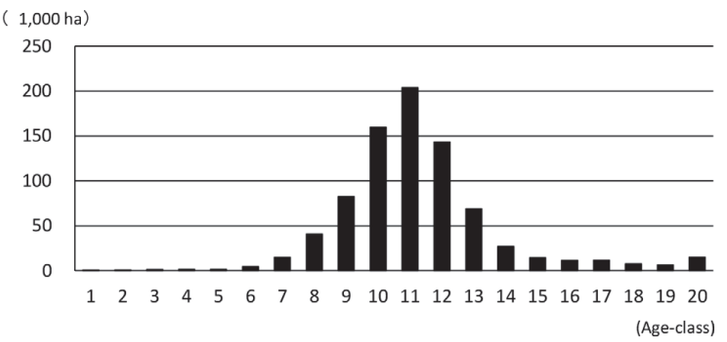

Figure 3.
Age–class distribution of pine plantation forests. Source: [17]. Note: In Japanese forest resource tables, one age-class equals 5 years. These data are calculated for forests under the forest planning system. The data in age-class 20 include age-class 21 and over.

the volume of damage has gradually decreased. After 2015, it was less than 0.5 million cubic meters, which was almost the same as in the 1960s.

Due to such long-term damage by the pine bark beetle, the annual area of pine trees planted has decreased. **Figure 2** shows the percentages of planted trees, classified by species. In 1955, the percentage of pine was 10.1%. The highest percentage of pine was recorded in 1962 at 18.4%. Since 1962, the percentage has decreased. It was less than 5% in 1980 and has been less than 2% since 1987. Pine has almost completely lost its role as the major plantation species as a result of the pine bark beetle. As the annual area of pine planted has decreased, the age distribution of pine plantation forests from age-class 1 to age-class 6 is exceedingly small (see **Figure 3**).

3. The legal system related to pine bark beetle management

3.1 The Forest Act prior to the Second World War

The first Forest Act (Act No. 46 of 1897) was enacted in 1897. The Forest Act was first proposed by a bill in 1872, but it, along with several succeeding bills, was killed [18]. The most important chapters of the first Forest Act were Chapter 2, on the regulation of forest practices, and Chapter 3, on forest protection.

Only one article on pests and diseases was included in the first Act. Article 36 required that people who discovered fire, pests, or disease in or near a forest, or who knew of someone that had committed a crime or attempted to commit a crime against a forest, should immediately report the details to foresters, police, or local government staff. In this version, forest pests and diseases were treated in the same way as fires and crimes.

The first Forest Act was amended in 1906 (Act No. 43 of 1906). It included the introduction of the Forest Owners' Association (FOA). Because it was difficult to prevent damage by pests and diseases using the same reporting systems as for fires and crimes [5], the Forest Act of 1906 contained three additional articles (Articles 80, 81, and 82) that directly addressed forest pests and diseases.

Article 80 stipulated that forest owners had a legal obligation to prevent and exterminate forest pests and diseases. Forest owners could even enter another owner's land to exterminate or prevent pests or diseases with the permission of foresters or police authorities. Article 81 stated that local governors could order interested forest owners to enact necessary extermination or prevention measures under sufficient threat. The extermination and prevention costs were incurred by the forest owners, depending on the forest area or value. Administrative subrogation was available, and the expense was compulsorily collected. The Act on the Extermination and Prevention of Pest Insects[7] (Act No. 17 of 1896), which defined the extermination of pest insects in the context of agricultural products, imposed a duty on farmers to attend to pest and disease management, whereas no such duty existed in the case of forest pests and diseases [19]. Article 82 defined that the right to demand compensation was denied for extermination and prevention of forest pests.

Under the Forest Act of 1907, the extermination and prevention of forest pests and diseases was the obligation of forest owners, who incurred related expenses[8]. This was an important feature of the act. When it was difficult for forest owners to control the spread of pests and diseases, local governors could order or carry out extermination and prevention measures.

The Order on Enforcement Procedures of the Forest Act (Ministry of Agriculture and Commerce, Order No. 30 of 1907) laid out the procedure for responding to the spread (or threat thereof) of forest pests and diseases into neighboring prefectures. Article 24 defined immediate reporting of the spread, and Article 25 defined the cooperative extermination and prevention measures [20].

Under the Forest Act of 1906, four types of FOAs were introduced. These included FOAs for planting, forest practices, forest roads, and forest protection. Members of each FOA acted cooperatively to plant trees, create forest management plans (FMPs), construct and maintain forest road systems, and prevent and manage forest fires, illegal cutting, and pests. While the establishment of FOAs was voluntary, once one was established all forest owners living within the jurisdiction of a FOA were required to join [21].

According to an example of the articles of incorporation of a FOA for protection [22], the contents of the business field defined in Article 2 were defense against forest fire, defense against theft, extermination and prevention of forest pests, and other detriments [20]. The expense distribution was to depend on the forest area holding (Article 9). There were numerous FOAs dedicated to forest practices, but

[7] This act excluded pest insects in forests.

[8] In the prewar legal system, pest control was the responsibility of forest owners; less than half of the total cost was subsidized by the prefectural government [6].

not the other three types. Many FOAs did not work substantially after their establishment [23]. Thus, it was not clear how many protection FOAs worked diligently towards the extermination of forest pests.

In comparison to the 1897 Forest Act, the 1907 Forest Act developed a clear legal system to deal with forest pests and diseases. However, there were only three articles, and, as the Forestry Agency pointed out, they were problematic [5]. The articles were too simplistic and were lacking in detail, there were many ambiguities as far as procedures, and the rule on forest owners' expenses was problematic from the standpoint of a workable system. Although the major objective of the 1897 Forest Act was forest resource management based on the regulation of forest practices and protection, a chapter on FOAs was added in the 1907 amendment that added three articles relating to pest and disease control. However, the Forestry Agency pointed out that the articles in the 1907 Forest Act had very few controls and that there had been only one prosecution for violation of the order, based on Article 81, in 1931 [5].

The 1907 Forest Act was partially amended in 1939 [24]. The most important part of the amendment was that FMPs had to be developed not only for public forests and forests owned by shrines and temples but also for all non-national forests. The government supervision system for non-national FMPs was contained in the amendment. Forest owners who held 50 ha or more were required to make individual FMPs, whereas for forest owners holding less than 50 ha the plans were the responsibility of the FOAs. The four types of FOAs were removed and new FOAs were established in all municipalities. No changes were made to the three articles relating to forest pests and disease control.

3.2 Pre-war acts other than the Forest Act

In the early Meiji period, before the establishment of FOAs in the 1907 Forest Act, local cooperative organizations were established based on common forests that originated in the mid-Edo period. Articles on forest protection were sometimes included in the rules and regulations of the cooperative organization. Local governments started to establish rules for non-national forests. For example, Mie Prefecture (1884), Fukushima Prefecture (1885), and Shiga Prefecture (1886) instituted a new regulatory rule for non-national forests [23]. In the case of Article 5 of Fukushima Prefecture's rule, protections against forest fires, illegal cutting, and pest insects were included [23]. Rules on forest protection, including pest control, existed in common forests and prefectural regulations, but it is unclear whether such rules were part of a workable system.

The utilization of trees damaged by forest pests in national forests was considered during wartime. Before the Second World War, basic management rules were determined by FMPs based on the ordinances of the national FMP (Ministry of Agriculture and Commerce, Order No. 42 of 1899; Ministry of Agriculture and Commerce, Order No. 9 of 1914). The central policy was sustained yield management, but it was difficult to maintain the sustained yield policy in national forests after 1940 because of a timber supply shortage resulting from a decrease in log imports and a shortage of forestry workers [25]. In 1940, the chief of the Bureau of Forest, Ministry of Agriculture and Forestry, sent a circular notice to the chief of the Regional Office of the Bureau of Forest regarding a temporary increase in timber production in national forests. As a result of the notice, 11 types of cutting activities were authorized that were not previously authorized in the national FMP. One was cutting trees when there was no possibility of recovery from the damage inflicted by pests and diseases. Effective control of pests and diseases required cutting and immediate removal of damaged trees, which could then be used.

3.3 Before the Forest Pest Control Act

The first pine bark beetle damage in Japan was found in Nagasaki Prefecture on Kyushu Island. The damaged area began to spread east (**Figure 4**). In the first year that statistical records of pine bark beetle damage began, only four prefectures were recorded as having damage: Nagasaki, Miyazaki, Hyogo, and Shiga. In that year, 93.8% of the total damaged volume in Japan was located in Hyogo Prefecture. In 1946, the final year in **Figure 4**, the number of prefectures containing damage increased to 17. At that time, damage spread to numerous western prefectures. By 1947, the number of prefectures containing damage had doubled to 34. By 1949, damage had spread to all of Japan except Hokkaido, and by 1950, all of Japan was affected.

Although the reliability of wartime record keeping is questionable, it is certain that damaged areas and the volume of damage began to increase during and after the Second World War. Several causes were identified. Shinrin Byogaichutou Boujo Kenkyukai pointed out the increase in cut-over pine forests at the time, which resulted from cutting for military uses and increased wood demand for post-war reconstruction [7]. Cut-over pine forests became the source of the pine bark beetle. Furthermore, forest products made of pine, which included mine timber and timber for ships and vehicles during the war as well as fuelwood, mine timber, and construction wood after the war, moved widely. This transfer contributed to the spread of the area subject to damage.

Before the enforcement of the new act on the pine bark beetle in 1950, Articles 80–82 of the Forest Act of 1907 were effective. The legal system had not worked well to prevent and deal with damage since around 1946 and that there were almost no measures to deal with the damage except in a few prefectures [27].

In 1948, a circular notice prohibiting transfer of pine logs with bark was sent from the Director-General of the Bureau of Forestry to the prefectural governors. Transfer of pine logs with bark from areas where pine bark beetle damage occurred to outside the prefecture was prohibited, and complete barking was required. In 1949, the Director-General sent another circular notice to the prefectural governors prohibiting fuel production from untreated damaged pine trees.

3.4 Enforcement of the Forest Pest Control Act

After the spread of the pine bark beetle, new legislation related to forest pests and diseases was enacted in 1950, called the Act on the Extermination and

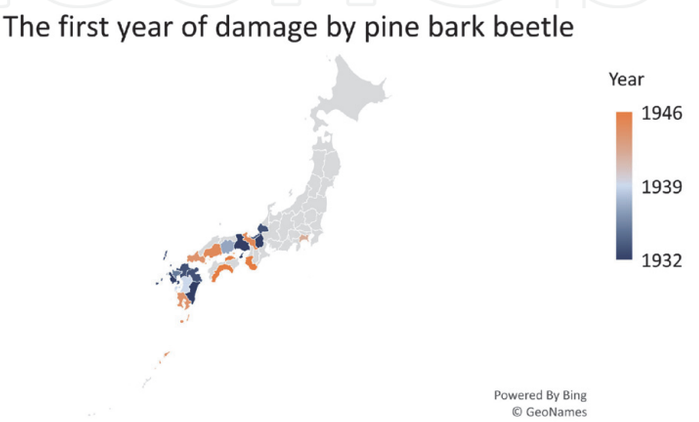

Figure 4.
First year of pine bark beetle damage (1932–1946). Source: [11, 26]. Note: Year means the first year when damaged volume was recorded. Record keeping of damaged areas first began in 1932.

Prevention of Pine Bark Beetle and Other Similar Borers and Other Destructive Forest Pests and Diseases[9] (Act No. 53 of 1950). Articles 81 and 82 of the Forest Act of 1907 were removed, and Article 80 was amended to say that forest owners could enter other owners' forests for the purpose of extermination and prevention. In the current Forest Act, the contents of this article are included in Article 49, which defines entry and surveying. The original purpose of Article 49 was to establish that, when necessary, forest owners could enter other owners' forest for measurement and onsite surveys related to forest practices with the permission of the municipal mayor. Article 49 would be applied mutatis mutandis when pests, animals, fungi, and viruses threatened to cause serious damage to a forest.

The new act of 1950 contained 16 articles and differed in several ways from the Forest Act of 1907. Prior to the enforcement of the act, the first GHQ recommendation[10] was made by Furniss [5].

As can be seen from the name of the act, the main objective was to establish countermeasures against the pine bark beetle. The Minister of Agriculture and Forestry or prefectural governors could order exterminations (Articles 3 and 5). For example, they could prohibit transfers of cut trees, which became a problem just after the war. A new finance system was introduced to provide compensation for prevention costs when ordered by the government (Article 8). A national subsidy was also determined in Article 9. Concerned officials or control members could conduct spot inspections (Article 6) and had the right to direct forest owners to take measures (Article 7).

The second GHQ recommendation [28] was issued in 1951, and in 1952, the act of 1950 was amended and renamed the Forest Pest Control Act (Act No. 26 of 1952). The species of pests and diseases were determined by related cabinet order, including seeds and seedlings for forestry. Six species were first identified; one was removed in 1958, and then three were added between 1952 and 1962, bringing the current total to nine. The original six species are borers that attach to and impede the growth of trees: pine caterpillars, pine needle gall midges, gypsy moths, *Diprion nipponica*, and field mice. *Diprion nipponica* was removed in 1958. Chestnut gall wasps, cryptomeria needle gall midges, cedar spider mites, and guignardia laricina were added in 1952, 1955, 1956, and 1962, respectively.

The Forest Pest Control Act was amended several times, and a significant amendment was made in 1967 that added control through pesticide application to the extermination order. Article 6 laid out the extermination order by the Minister of Agriculture and Forestry. There were six types of orders listed in the article, and (4) is as follows: to order a person who owns or takes care of trees or designated seeds and seedlings to which damage is being caused or is likely to be caused by forest pests to carry out control through pesticide application.

3.5 Enactment of The Act on Special Measures Concerning the Control of Pine Bark Beetle

As shown in **Figure 1**, the damaged volume began to increase again, reaching a second peak of 2.4 million cubic meters in 1979. The Forestry Agency identified three causes for the increase during this period.

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[9] The name of the act was taken from the name of the bill, including the following GHQ/SCAP documents: GHQ/SCAP Records (RG 331, National Archives and Records Service), Box No. 3007, Folder title: Pine Bark Beetle Program.

[10] A summary of the first recommendation is included in [28].

The first cause was a decrease in the demand for fuelwood spurred by a fuel revolution [7]. The percentage of the total cutting volume of wood used for fuel decreased linearly (see **Figure 5**). In 1972, it decreased to 3.0%. As a result, demand for damaged pine trees decreased significantly, and dead trees and branches left in forests became sources of new damage. The second cause was a decrease in the chip price of pine, which resulted in worsening profits from the production of pine and pine forest management [7]. Some owners abandoned pine forest management, along with pine bark beetle control. The third cause was typhoon damage in 1971 and extraordinary climatic conditions in 1973 [7]. Except for climatic causes, economic factors such as a decrease in pine tree demand and decreases in the price of pine chips contributed to the expansion of the volume damaged in the 1970s. Under these conditions, the Act on Special Measures Concerning the Control of Pine Bark Beetle (Act No. 18 of 1977) was enacted as 5-year temporary legislation.

The objective of this act was to protect important forest resources from the increasing damage caused by the pine bark beetle. During the 5 years from 1977 to 1981, the government planned to conduct intensive extermination to halt pine bark beetle damage. As seen in **Figure 1**, the annual volume of damage from 1978 to 1981 was over 2 million cubic meters. The effective period of the Act on Special Measures was almost equal to the period when the volume of damage was at a record high. When the temporary act expired on 31 March 1982, the effective period was extended for an additional 5 years under the new name Act on Special Measures Concerning the Damage of Pine Bark Beetle (Act No. 21 of 1982).

Under the extended act, five integrated methods were identified to exterminate and prevent pine bark beetle damage. The methods were pesticide application from aircraft and above ground, applying pesticides to felled trees, special felling (after which crushing, incineration, or charring could be necessary), and tree species replacement. Tree species replacement was a new policy. Paragraph 4 of Article 3 of the act outlined replacement. To protect pine forests and maintain their various functions, the policy called for replacement with species other than pine that were unlikely to be affected by the pine bark beetle.

The area in which new species[11] were planted is shown in **Figure 6**. A maximum of about 9,000 ha was planted in 1982 (the first year in which the method was implemented), decreasing gradually to about 4,000 ha in 1987. In 1987, the area of

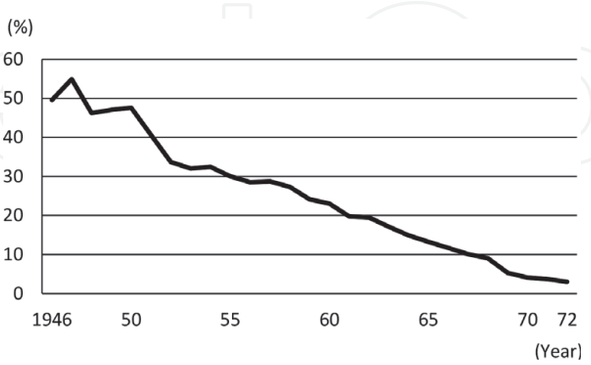

Figure 5.
Fuelwood as a percentage of total cutting volume. Source: [12]. Note: The statistical survey on cutting volume for fuelwood ended in 1972.

[11] Most of them are broad-leaved trees. In the case of plantation forest, the recommended species by the Forestry Agency is Japanese cypress, *Quercus acutissima*, etc. (Forestry Agency, https://www.maff.go.jp/j/kokuji_tuti/tuti/pdf/t0000211_2.pdf, 2020/11/05).

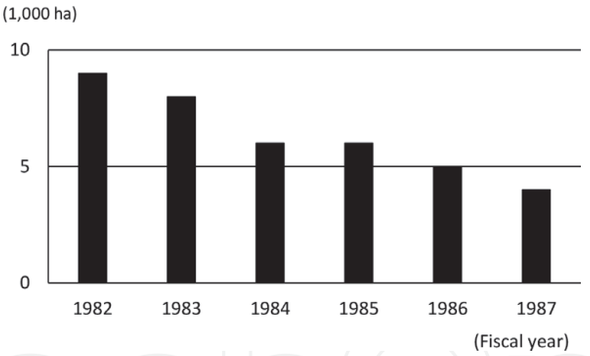

Figure 6.
Area of plantation forests replaced with other species. Source: [7].

damaged pine forest was about 610,000 ha[12] [7], and the area of plantation forests planted with new species under the replacement policy was equal to 0.7% of the total damaged area. This area was limited because of the lack of motivation to cut pine trees due to the economic situation of the forest products market (for example, decreased timber prices) [7]. It was difficult to replace tree species without clear-cutting, and even after a clear cut, the trees had to be removed. Without hauling, it is difficult to plant new species.

For example, in Iwate Prefecture, tree species replacement was conducted on 93 ha in 2016 [29]. Iwate Prefecture is located in the northern part of Honshu Island and pine bark beetle damage is now spreading. It was pointed out that there is a cooperative policy regarding the use of damaged trees by woody biomass powerplants, as well as encouragement of forest owners by municipal offices and local FOAs to cut damaged trees. It is difficult to conduct tree species replacement without a system for utilizing the damaged trees.

As shown in **Figure 2**, newly planted pine forests decreased substantially after the 1980s. The area of pine forests decreased as a result of the damaged forests and the replacement policy.

Expiration of the Act on Special Measures of 1982 was postponed in 1987 and 1992, finally lapsing on 31 March 1997. At that time, the Forest Pest Control Act (Act No. 26 of 1952) was amended to follow the control methods[13]. In the official document,[14] the amendment stated that the damaged volume had decreased by almost 60%, from 2.43 million cubic meters in fiscal year 1979 to 1.01 million cubic meters in fiscal year 1995, and that the spread of damaged areas had almost been stopped. The volume of damage was still high, and the document highlighted the possibility of damage again increasing due to climatic conditions. It also highlighted the need to strengthen forest pest control systems for early detection and quick extermination. Levels of forest management were declining in general due to changes in the business environment of the forestry industry. A special felling method included in the expired act was carried over into the amended Forest Pest Control Act.

[12] 590,000 ha of the total damaged forest area (610,000 ha) was non-national forests. As the percentage of non-national forest is almost 70% of the total area, the likelihood of pine bark beetle damage in non-national forests was extremely high.

[13] When the Act on Special Measures lapsed in 1997, treatment of trees in which the degree of damage was not serious could become part of forest improvement projects. This practice was identified in the Forest Improvement Conservation Project Plan based on Article 4 of the Forest Act of 1951.

[14] On the enforcement of the amendment of the Forest Pest Control Act (Document No. 9-Rinya-Zou-100, April 1 of 1997) https://www.maff.go.jp/j/kokuji_tuti/tuti/pdf/t0000205.pdf, 2020/08/23

4. Discussion

4.1 GHQ recommendations and their present-day significance

The first peak of damage caused by the pine bark beetle occurred just after the end of the Second World War when GHQ occupied Japan (from 1945 to 1952). GHQ/SCAP pointed out challenges with prevention during wartime [15]. The damaged volume began to increase during the war, and it continued to increase substantially afterwards, especially in non-national forests (see **Figure 1**). Even now, 75 years after the end of the war, the damage has not been contained. Analyses of policies and related reports, especially those written by GHQ, are therefore of great importance.

During the occupation of Japan, GHQ made various recommendations in the field of forestry. The Natural Resource Section (NRS) published many reports and made many recommendations, including two by Furniss regarding forest pest control. This section discusses the present-day importance of these recommendations. While many of the recommendations were technical in nature[15], the focus of this section is primarily on four aspects of their legal and administrative contents (including the first recommendation by Furniss in 1950, hereafter referred to as "the recommendation").

The first point concerns issues with the pre-war legal system, especially Article 80 of the Forest Act of 1907. This article set out the obligation of forest owners to exterminate and prevent pine bark beetles. The recommendation also required the government to make a unified extermination plan. The basic policy framework differed between the recommendation and the Forest Act of 1907. When pest control is the responsibility of the national government, differences in damage to national and non-national forests will not occur. According to **Figure 1**, the problem occurred mainly in non-national forests. When pest control is the responsibility of private forest owners, extermination and prevention measures depend on the will of the forest owners and their management situation. After the end of the war, the three organizations formerly responsible for national forest management were unified into one organization, and new national forests were to be managed by an independent accounting system subject to the National Forest Management Special Account Act[16] (Act No. 38 of 1947). Under the special accounting system, regional and local national forest offices conducted pest control only in national forests. If adjacent non-national forest was damaged by the pine bark beetle, it was difficult for the national forest to conduct certain extermination measures.

In the 2012 amendment of the Forest Act, a new system of cooperation between national and non-national forests concerning the public interest was created (Article 10.15–10.19). In the case of thinning, a national forest could sign an agreement with a private forest owner, whereby the national forest could outsource the forest management of both areas to a forestry company with a copayment by the private forest owner. Another case of cooperation was in the extermination of non-native species at World Natural Heritage sites and candidate sites. To date, only these two types of cooperation exist, and this system has not been applied to pine bark beetle extermination. It remains difficult to conduct forest practices, including joint pest

[15] For example, Nakano [30] of the Government Forestry Experiment Station commented that some of the technical contents were different from his experience. The different opinion by the Chief of the Department of Forestry in Yamanashi Prefecture was also referred to in [30].

[16] This special account act was abolished by the enactment of the Act on Special Accounts (Act No. 23 of 2007).

control, even now. In Japan, the basic policy framework clearly delegates management of national forests to the Forestry Agency and management of non-national forests to forest owners, local governments, and FOAs. Generally, in the case of national forests, a public bidding system determines which companies will perform work, while in non-national forests, negotiated contracts are used. With regard to pest control, this difference seems to be a considerable barrier.

A similar problem was pointed out in GHQ/SCAP [10]: "Further, the outstanding characteristics of the present bark beetle control activities in Japan have been lack of a coordinated program and lack of an adequate organization to carry on control." While the situation has changed greatly over the past 70 years, generally speaking, the vertically segmented administrative system[17] still exists in Japan. Individual countermeasures against damage in national and non-national forests is a typical example[18].

Second, it is worth noting that the recommendation referred to non-economic forest and trees. In the Forest Act (Act No. 249 of 1951), three articles relate to the definition of a forest. Article 2 prepares the definition of a forest, excluding trees on land that was mainly utilized as farmland, residential land, etc. Trees on residential land, including housing shelter trees, windbreak trees on farmland, and trees in Japanese gardens, are excluded. The basic Japanese forest resource program is a forest planning system. The forests to which the forest planning system applies is defined by Article 5, which excludes isolated small forests (less than 0.3 ha) in city areas in the Regional Forest Plan prepared by prefectural governments. Article 10 (4) excludes from the Regional Forest Plan experimental forest sites in university forests and forest on the grounds of a temple or shrine. Forests excluded in Articles 2, 5, and 10(4) are generally small and are not primarily managed for timber production.

As for pine forests, both timber production and non-production forests are important for measures against pine bark beetle damage. The definition of forests to which the Forest Pest Control Act applies is unclear from its articles, meaning that all pine forests may be included. The total forest management plan, which includes all forest practices, including extermination and prevention of pine bark beetle damage, has some importance for controlling damage.

Third, the recommendation pointed out the necessity of amending the Forest Act and prefectural forestry regulations. The Forestry Agency stated that the recommendation created momentum for amending the prewar legal system concerning damage by forest pests and diseases [5]. An amendment of the legal system could be realized by using the outside political pressure that the GHQ recommendation represented. The increase around the second peak in 1978 followed the enforcement of the Act on Special Measures Concerning the Control of Pine Bark Beetle in 1977. As shown in **Figure 1**, the volume of damage has decreased since the second peak, although it remains high and almost equal to that in the 1960s. Although there is no outside pressure, the necessity of improving the legal

[17] GHQ/SCAP [10] pointed out the situation of forest research, including forest insect research. In the paragraph on this topic, the following sentence was included; "entomologists who were unable to translate their detailed biological findings into terms of practical control." This means that there was a communication problem between the research and administrative sectors.

[18] Furniss [28] noted the following passage as a part of "progress and problems in 1950": "The responsibility of the central government for control of forest insects, both on national forest and private forest lands, should be placed in one organization in the Forestry Agency." This recommendation has still not been followed.

measures related to pine bark beetle damage exists, at least regionally, especially in the northern Honshu Island prefectures where the volume of damage is increasing.

Finally, the necessity of an investigative organization and correct data collection[19] should be noted. This recommendation applies not only to pine bark beetle damage but also forest resource statistics. For example, GHQ/SCAP [10] pointed out the lack of dependable statistics and a comprehensive forest survey for forest resource management. GHQ/SCAP [10] also pointed out the lack of dependable statistics on tourism and recreational activities in national parks. After the end of the Second World War, the forestry sector statistical system developed, but development in the field of statistics regarding damage to forests remains poor. It is difficult to assess the damaged area, volume and value correctly, particularly in the case of forest pests and diseases. The level of concern on the part of plantation forest owners has significantly decreased for various reasons, such as low profitability, aging, and an increase in absentee forest owners. As a result, developing statistics on damaged trees is difficult. Since it is difficult to make an adequate control plan without reliable statistics, the recommendations made by GHQ regarding the need for investigative organizations and data-collection mechanisms still apply.

4.2 Utilization of damaged pine trees

Effective utilization of damaged trees is another important issue related to extermination and prevention. Furniss' first recommendation in 1950 was to use the damaged trees as much as possible[20]. As previously mentioned, at around the first peak in 1948, one of the causes of the increase in the volume of damage was abandoned damaged trees or logs. At the time, there was demand for fuelwood and various types of industrial round wood, but moving the damaged logs became a problem. By the time of the second peak in 1978, the decreased demand for pine logs due to the decreased demand for fuelwood and the price of chips was the precursor to increases in damage. Finding uses for damaged trees motivates removal, which helps to prevent the further spread of the pine bark beetle.

Although the data are old, statistics on the utilization of damaged pine logs from the mid-1980s are available. The 1980s was a period of decreasing damage just after the second peak of 1978, and the Act on Special Measures Concerning the Control of Pine Bark Beetle (Act No. 18 of 1977) was postponed and renamed in 1982. Figures on the total damaged and utilized volumes are shown in **Figure 7**. Both damaged and utilized volumes decreased in the mid-1980s. The percentage of utilized volume decreased from 13.1% in 1983 to 10.5% in 1987. Unutilized damaged volume should be treated in some way or left in the forest, and it is possible that damaged trees and logs left in the forest preceded subsequent damage.

As shown in **Figure 1**, even though the damaged volume has decreased, it is still large at 0.4–0.5 million cubic meters. Although the statistical details are unclear, it seems that utilization of damaged trees and logs is insufficient. Although the

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[19] GHQ emphasized data collection. For example, a summary of results from the Japan Pine Bark Beetle Conference held in several cities in August 1950 showed key points addressed by Mr. D. J. Haibach of NRS, GHQ/SCAP. The first point was accurate surveying and reporting of infestation, which was the foundation of building an effective pine bark beetle control program (GHQ/SCAP Records (RG 331, National Archives and Records Service), Box No. 3105, Folder title: Pine Bark Beetle Control: by Kessler, Jeneye).

[20] At that time, labor-intensive countermeasures against pine bark beetle damage established immediately after the Second World War have had an economic impact, as a component of unemployment relief projects [31].

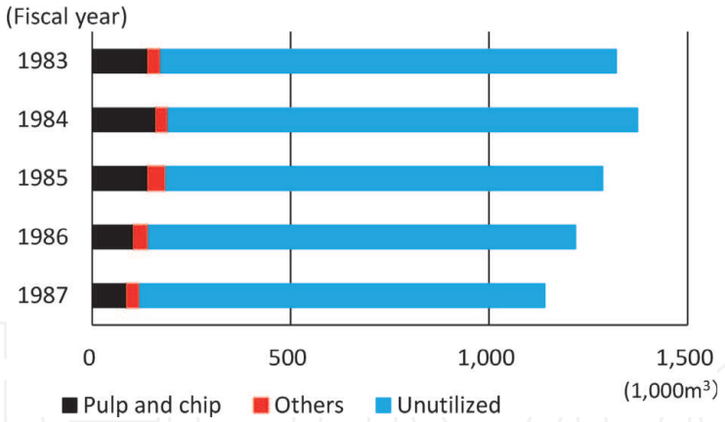

Figure 7.
Utilization of damaged pine trees. Source: [7] for utilized volume; [13] for damaged volume. Note: "Others" is the total logs for fuelwood, lumber, etc. "Unutilized" volume was calculated by subtracting the total volume used for "pulp and chips" and "others" was calculated from the total damaged volume.

utilized volume is not specified, the Forestry Agency [2] stated that examples of utilized damaged trees include fuelwood and chips supplied to paper mill companies.

The current significant change in domestic timber demand comes from increased demand from woody biomass powerplants (see **Figure 8**). It is worth noting that the self-sufficiency rate increased in 2017 and decreased in 2018. The increase in the volume of chips supplied to woody biomass powerplants from 2017 to 2018 was 0.23 million cubic meters from domestic sources, while 1.05 million cubic meters were imported. Thus, the demand for domestic fuel decreased while that for imported fuel accelerated.

While poor quality limits their utilization in construction, damaged trees can be used in woody biomass plants. For example, in the mid-1980s, pulp and chips represented between 73.3% and 83.9% of the total utilized volume. The current increase in the number of woody biomass powerplants might be expected to follow in lock step with the increase in utilization of trees damaged by the pine bark beetle.

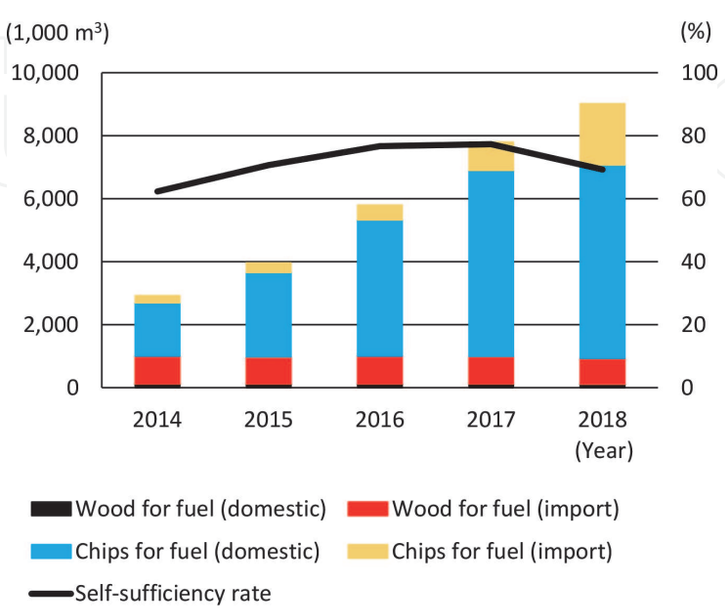

Figure 8.
Consumption and self-sufficiency rate of fuelwood. Source: [2]. Note: The vertical axis on the left side is fuelwood consumption and the vertical axis on the right side is the self-sufficiency rate.

However, there are three reasons why the increase in demand for fuelwood may not result in an increase in the use of damaged trees.

The first is the price of fuelwood used by woody biomass powerplants. The standard price is set by the feed-in tariff (FIT) system for renewable energy. To obtain the highest fuelwood price, logs should be supplied from forests with FMPs developed by forest owners in non-national forests. This plan was introduced with the amendment of the Forest Act in 2011, and the planning period is 5 years. A notable characteristic of the plan is that timber production should be planned in coordination with subsidized forest road or spur road construction. Although it is possible to design an FMP for forests damaged by the pine bark beetle, in practice, the plan is geared towards Japanese cedar and Japanese cypress plantations. For most FMPs, the objective is thinning associated with subsidized road construction, and forests where thinning has occurred will be expected to conduct final cutting thereafter. Namely, it is assumed that the forest with normal growth; very few FMPs for pine forest include preparation by forest owners for the possibility of future damage by the pine bark beetle. Moreover, many forest owners cease pine forest management in the face of continuing long-term pine bark beetle damage. At the end of fiscal year 2014 and 2018, 28% and 29%, respectively, of all non-national forests had FMPs [2, 32].[21] The area covered by FMPs has not increased recently.

The original policy motivation for promoting woody biomass powerplants with the FIT system was to make use of unutilized domestic wood resources. There are many types of unutilized wood resources,[22] such as thinned trees that are left in the forest, construction waste materials from the demolition of old wooden structures, residue from sawmills, remnants left behind after removing logs from forests, and damaged trees.

In the case of trees damaged by pests and diseases, the price of logs for fuelwood should be given special treatment. A new financial distribution system from the central government to municipal governments started in April 2019, and the use of the funds as regards forests, forestry, and wood should be determined. For example, municipal governments may add grants to the price determined by the FIT system. This type of pricing policy should be considered to increase the use of damaged trees.

The second cause is a problem common in the Japanese forestry sector, which is the shortage and aging of forestry laborers. Given the limited labor availability, forestry companies and FOAs prioritize forest practices linked to the production of timber or that are more profitable. Otsuka [33] analyzed the problems surrounding the use of trees damaged by pine bark beetle at the biomass powerplant in Iwate Prefecture. One problem is that tree felling is a countermeasure to the damage and that the practice is not based on the premise that the felled trees should be taken out. Another problem is that supply of felled trees due to damage is unstable because the felling period is limited. Hayashi et al. [34] analyzed the use of damaged trees in a paper and wood-pellet company in Yamagata Prefecture and pointed out that there is a benefit for wood companies to get damaged materials at a cheaper price compared to healthy trees[23]. At the same time, the instability of the volume of damaged trees is a problem.

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[21] There are no statistics on the relationship between FMPs and plantation tree species.

[22] In 2018, utilized residues from sawmills and construction waste materials were extremely high at 98% and 96%, respectively, while forest residue utilization was only 24% in 2017. The low utilization rate is a problem in all forests, including those damaged by pine bark beetle [2].

[23] Hayashi *et al.* [34] pointed out that the increased utilization of pine bark-damaged trees by woody biomass powerplants would make business sense since they are cheaper. Although there is a possibility to

In these two recent analyses, supply stability was commonly pointed out as being a problem. As shown in **Figure 1**, annual changes in the volume damaged are not large at the national level, however, they tend to be large at the prefectural level because the damaged area shifts from year to year. The damaged volume should decrease in the future due to various countermeasures. Because moving damaged trees long distances is undesirable, it is difficult to collect trees from a wide area, for example, across several prefectures. This must be considered in analyzing the effective utilization of damaged trees.

From the discussion above in Section 4.2, the mismatch between the large volume of damage and the potential volume for fuelwood and chips should be pointed out. Utilizing damaged logs, including those damaged by the pine bark beetle, should be taken into consideration in policy development.

In the current forest planning system designated in the Forest Act, the utilization of damaged trees is not clearly specified. This needs to be done in the national government's National Forest Plan and the prefectural Regional Forest Plans[24]. Furthermore, the Forest Pest Control Act of 1950 focused on extermination of damaged trees and preventing damage,[25] but not utilization of damaged trees. One reason for this problem seems to be the different administrative systems for dealing with timber production and forest protection within the Forestry Agency and the Department of Forestry in prefectural governments. The problem, pointed out by GHQ and discussed in Section 4.1, is related to the lack of a coordinated program.

4.3 Forest practice

Recommendations by Furniss to GHQ in 1950 and 1951 included improvement of forest practice methods for dealing with forest pests. Legal systems, such as the Forest Pest Control Act of 1950 and the Act on Special Measures Concerning the Control of Pine Bark Beetle of 1977, did not include how to conduct forest practices. The basic contents of these legal systems were measures related to damage. As shown in Section 4.2, the post-war forest planning system in the Forest Act of 1951 did not consider the use of damaged trees, and the FMP system deals with normal forest management. The GHQ recommendations have not been implemented in postwar legislation relating to forest pest control.

4.3.1 Forest management plan

In the GHQ recommendations, the necessity of a better FMP was pointed out, but an FMP system for forest owners was not introduced in the Forest Act of 1951. An FMP system was introduced in the amendment to the Forest Act of 1939 [24], but it did not work well due to wartime timber production. In the first post-war forest planning system, a 5-year national plan was made by the Minister of the Ministry of Agriculture and Forestry and a 5-year prefectural plan was made by prefectural governors. Under this system, central and local governments had an

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use the damaged trees, expansion of damage by the pine bark beetle is not acceptable. It was pointed out that a decrease in fuelwood supplied from damaged trees is desirable.

[24] The great increase in timber demand after the Second World War demanded the utilization of trees damaged by pine bark beetles [6]. After the second peak, the transport of untreated damaged trees to sawmills, pulp factories, and building sites widened the spread of the damaged area [8]. Thus, the movement of damaged trees should be limited to smaller areas, such as the sub-prefecture scale area covered by the Regional Forest Plan, which appears to be appropriate for limiting beetle spread.

[25] Kobayashi [35] proposed using damaged trees as a preventative measure. Use of damaged trees is not included in the Forest Pest Control Act.

obligation to make forest plans.[26] Ultimately, the FMP referred to in the recommendation[27] by Furniss as an indirectmeasure for pest control was not introduced.

In the current forest administration and forest planning system, the increase in forests with unknown owners and unknown boundaries has become a problem[28]. The recommendation of the FMP as an indirect measure to control forest pests assumes that forest owners know the contents of their holdings. However, this is oftentimes not the case, and sometimes forest owners do not know that they have inherited forest. As a result, they cannot make FMPs by themselves.[29] One of the reasons forest owners do not have sufficient knowledge of their holdings was the abolition of the FMP system by forest owners under the Forest Act of 1939 amendment and the introduction of the forest planning system primarily by central and local governments in the Forest Act of 1951. Even in such an administration-led forest planning system, in the 1950s, the percentage of fuelwood in the total cutting volume was high (see **Figure 5**) and forest owners seemed to have a good understanding of their holdings. Such a relationship has now disappeared in most areas. Since most forest owners have no relationship to their holdings and rarely go into their forests, they cannot find beetle damage.

4.3.2 Cutting methods

Furniss' first recommendation was that damaged trees should be utilized as much as possible. Furniss [28] recommended the "Selective removal of infested trees only[30]". Almost at the same time, a recommendation on private coniferous forests by Kircher and Dexter pointed out the necessity of a better FMP, the elimination of clear-cutting on steep slopes, and the establishment of partial cutting methods.[31] The recommendation required the cessation of clear-cutting, especially on steep slopes. Furniss and Kircher and Dexter did not recommend clear-cutting. One reason for this was the existence of large areas of denuded forest (roughly 1.72 million hectares at the end of fiscal 1948) at the end of the Second World War [39]. This situation resulted in extensive damage resulting from natural disasters associated with the denudation, such as landslides.

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[26] Please see [36] on the forest planning system. As regards the current system, please see the webpage (in Japanese) of the Forestry Agency: https://www.rinya.maff.go.jp/j/keikaku/sinrin_keikaku/pdf/taikeizu24.pdf, 2020/09/12

[27] Furniss [28] recommended the following: "Research should be undertaken to develop methods for the lasting control of bark beetles and other forest insects through improved forest management practices and thereby reduce the necessity for direct control expenditure. Early implementation of the forest management plan program is a logical first step towards attaining indirect control of bark beetles through improving the vigor of the host trees."

[28] This problem relates to the aging of forest owners [37].

[29] Under the current Forest Act, forest owners who own over 100 ha can make an FMP by themselves. However, forest owners who own less than 100 ha must band together to achieve the required area. Many forest owners cannot make a FMP by themselves.

[30] According to a summary of the first recommendation by Furniss [28], "The present practice of felling the infested trees and peeling and burning the bark of infested trees [should] be retained as the principal direct control measure, but the practice of clear-cutting entire stands for bark beetle control [should] be discontinued. Selective removal of infested trees only is recommended."

[31] Kircher and Dexter [38] recommended two systems for the management of coniferous forests: "(1) a shelterwood system or (2) a partial cutting system which will build up a several- or many-aged stand."

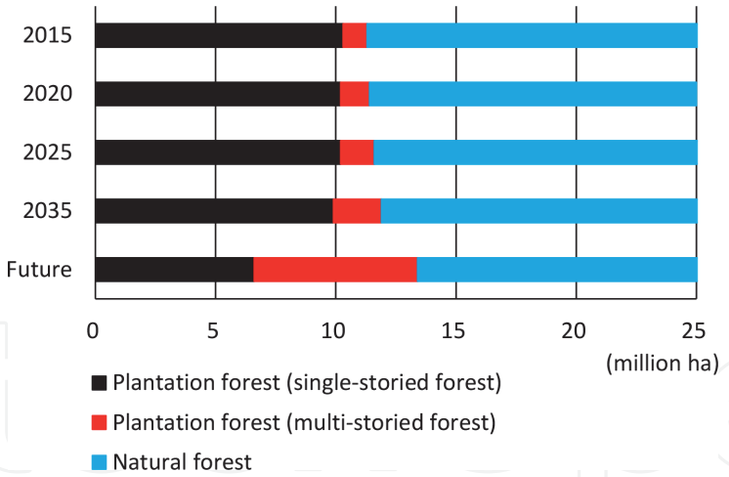

Figure 9.
Current and future forest areas based on the 2016 Basic Plan on Forest and Forestry. Source: [32]. Note: The total forest area for all years, including "future," is 25.1 million hectares. "Future" indicates goal-directed forest projections.

Nonetheless, selective cutting has developed only to a limited degree in specific areas since the end of the war, with clear-cutting remaining the dominant method in Japan. Thus, it follows that selective cutting has not been extensively adopted as a method for managing trees damaged by the pine bark beetle.

The Basic Plan for Forest and Forestry, based on Article 11 of the Forest and Forestry Basic Act (Act No. 161 of 1964), which is revised roughly every 5 years, determines the forest area classified by forest type since 2001. The current Basic Plan was published in May 2016, and the areas classified as single-storied plantation forest, multi-storied plantation forest, and natural forest are shown in **Figure 9**. The basic idea of future forest management is to increase multi-storied plantation forests. In "future," which shows the final ideal situation, the area of single-storied plantation forests is 6.6 million hectares and the area of multi-storied plantation forests is 6.8 million hectares. Methods other than clear-cutting will be necessary to change single-storied plantation forests and natural forests to multi-storied forests. An increase in multi-storied plantation forests has been delayed because of the long-standing use of clear-cutting. However, if the basic idea is realized and forest practice techniques other than clear-cutting are developed, there is the possibility that damaged trees can be cut selectively and removed for use to some degree.

Selective cutting is most viable in the early stages of damage, after which point widespread damage makes it difficult. In the act of 1982, tree species replacement was added to the list of measures against pine bark beetle damage. Considering that damaged areas influence surrounding areas over the long-term, the basic idea that damaged trees should be cut, removed, and used to the greatest extent possible is still important.

5. Conclusion

In light of the failure of the Japanese government to contain the spread of the pine bark beetle, this chapter explored the legal aspects related to its management. The first and second peaks in the volume of damaged trees were recorded in 1948 and 1978, with the second peak being larger than the first. Furniss' two recommendations on forest pest control to GHQ-occupied Japan at the end of the Second World War were followed by new legislation. In the Act on the Special Measures of

1982, the tree species replacement method was added to the list of countermeasures against the damage.

In analyzing the legal measures taken to combat pine bark beetle damage from 1897 to date, several important points emerge.

The first is the lack of a coordinated program. This was pointed out by GHQ not only for pest control policies but also for other forest and forest-related policies. Cooperation between national forests, administrated by the Forestry Agency, and non-national forests, administrated by the Departments of Forestry for each prefectural government, is lacking. Cooperation between local governments and forest owners is also lacking. Accurate statistics[32] and reporting systems resulting from coordination amongst administrative sectors, FOAs, and forest owners are needed.

The second point is that the use of damaged trees, as recommended by GHQ, has not increased. Utilization of damaged trees as fuelwood for woody biomass powerplants and as chips for paper companies has been expected to increase, but these projected increases have not yet been realized, partly due to cheaper prices for fuelwood from damaged forests.

The third point is that countermeasures against pine bark beetle damage do not include FMPs. There is no linkage between pest control and the forest planning system. Despite GHQ pointing out the necessity of making better FMPs and the cessation of clear-cutting, both have gone unrealized.

The failure of the Japanese government to heed these recommendations has resulted in pine no longer being the dominant plantation species in Japan. Young trees are almost non-existent. Not only is pine important for the scenic beauty of forests and Japanese gardens, it is also a necessary material in traditional Japanese construction.

The volume of damage has decreased by almost 80% compared to the volume of damage at the time of the second peak, however, it remains large and the damaged area is expanding every year. Both legal and technical developments are needed to stop this expansion.

Japan recently implemented new forest policies. In fiscal year 2013, the financial system for national forest management changed from a special accounting system to a general accounting system. In 2019, the Forest Environmental Tax began generating new forestry funds that are distributed from the central government to municipal governments. The recent Basic Plan for Forest and Forestry showed a shift towards multi-storied plantation forests for future forest management. These recent changes, however, have not influenced legal policy changes with respect to pine bark beetle damage. Post-war GHQ recommendations are still valuable today and could play an important role in constructing forestry policies to combat pests.

Acknowledgements

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[32] Accurate statistics on forest damage are necessary. In the forest resource database for non-national forests managed by the Department of Forestry in each prefectural government, called "*shinrinbo*," volume has generally been calculated using the fixed yield table. In the areas classified by species, damaged and non-damaged forests are not distinguished. As a result, the area of pine forest has not decreased in spite of the spread of damage. For example, Futai [40] pointed out that the areas of pine forest in 1980 and 1990 in Kyoto Prefecture were almost equal, despite the large volume damaged.

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