Impacts by feral goats on critically endangered *Crepidiastrum grandicollum* (Compositae) endemic to the Ogasawara Islands

Tetsuto Abe

Kyushu Research Center, Forestry and Forest Products Research Institute, Kumamoto, Japan

Correspondence
Tetsuto Abe, Kyushu Research Center, Forestry and Forest Products Research Institute, Kurokami 4-11-16, Chuo-ku, Kumamoto 860-0862, Japan.
Email: tetsuabe@ffpri.affrc.go.jp

Funding information
The Global Environment Research Fund, Grant/Award Number: F-51

Abstract
Oceanic islands are biodiversity hotspots with highly endemic ecosystems that are vulnerable to invasive alien species. Understanding the status of endangered species and identifying threats have the highest priority for insular biodiversity conservation. The two remaining populations of endangered *Crepidiastrum grandicollum* on Chichi-jima Island were studied for 5 years to describe their status and evaluate the impacts of feral goats (*Capra hircus*). The main cause of population decline was browsing by goats. The populations protected by the exclosures were stable but declined after an exclosure was removed. Even in the protected population, regeneration was limited outside the exclosures and in 1 year of the survey, a high proportion of feeding damage by moth larvae was observed in one population. These facts indicate that exclosures are not a sufficient conservation measure, and eradication of goats and population restoration in novel habitats are necessary to reduce the extinction risk of *C. grandicollum*.

KEYWORDS
alien herbivorous mammal, conservation strategy, endangered plant, exclosure, oceanic island

1 | INTRODUCTION

Oceanic islands are biodiversity hotspots with highly endemic ecosystems, which exhibit various island syndromes such as loss of dispersal ability, woodiness in herbaceous species and an increase in dioecious plants (Carlquist, 1974; Whittaker & Fernandez-Palacios, 2007), but insular ecosystems are vulnerable to invasive alien species (Couchamp, Chapuis, & Pascal, 2003; Walsh et al., 2012; Whittaker & Fernandez-Palacios, 2007). In particular, alien herbivores have a considerable impact on insular vegetation (Fernández-Lugo, Arévalo, de Nascimento, Mata, & Bermejo, 2013; Hamann, 1975) and populations of endemic endangered plants (Atkinson, 1989; Caujapé-Castells et al., 2010; Simbaña & Tye, 2009). Insular plants have often lost the ability to defend against herbivory by alien animals as a result of long-term isolation (Atkinson, 1989; Bowen & Van Buren, 1997; Carlquist, 1974; Couchamp et al., 2003). Additionally, the distribution of insular plants is generally restricted to limited areas on the small islands. These factors increase the extinction risk of insular plants under anthropogenic disturbances, resulting in a higher extinction risk of insular plants than that of continental plants (Kier et al., 2009; Sax & Gaines, 2008). Conservation of such endangered species is the highest priority issue for protecting insular biodiversity (Caujapé-Castells et al., 2010). For successful conservation planning, it is necessary to identify whether...
populations of endangered species are stable or declining, and if the latter, the causes of decline.

The ecosystems in the Ogasawara Islands have also experienced considerable impacts from alien species (Abe, Kato, Wada, Makino, & Okochi, 2011a; Abe, Makino, & Okochi, 2008a; Abe, Tanaka, & Shimizu, 2020; Chiba, 2010; Shinobe, Uchida, Mori, Okochi, & Chiba, 2017; Sugiura, 2009). Feral goats (*Capra hircus*) have been causing serious problems in the Ogasawara Islands, just as they have on other islands around the world. This poses a threat to the population of the endemic endangered shrub *Stachyurus praecox* var. *macrocarpus* (Abe, Wada, & Nakagoshi, 2008b), *Crepidiastrum linguifolium*, endemic endangered herb *Lobelia boninensis* and *Ajuga boninsimae* (Toyoda, 2003), helps alien species to dominate by suppressing native tree regeneration (Abe, Yasui, & Makino, 2011b), and has completely destroyed vegetation in some places, causing soil erosion (Hata, Kohri, Morita, Hiradate, & Kachi, 2014). Although goats also feed on alien plants, native plants decline because invasive alien plants recover quickly after the disturbance (Osawa, Hata, & Kachi, 2016).

*Crepidiastrum grandicollum* is one of four woody Compositae species endemic to the Ogasawara Islands, and speciated with two other endemic *Crepidiastrum* species within the islands (Ono, 1991). Most *C. grandicollum* individuals have soft herb-like stems and a relatively small size with a height range of 15–20 cm (Figure 1a). Insular woodiness is considered to have advantages in adapting to insular environments because of the longer life cycle and larger reproductive output (Nürk, Atchison, & Hughes, 2019). Therefore, it is a mystery why this species has such incomplete traits that seemingly contradict the hypothesis of insular woodiness. The possible reason is that it is simply within the evolutionary process of lignification or is the result of adapting to some other selective pressures that act on the evolution of insular woodiness. Therefore, this species may be important to understand the evolution of insular plants. The distribution of *C. grandicollum* is, however, limited only to Chichi-jima Island and Ani-jima Island, and the typical habitat is sunny rocky areas. The overall population size is extremely small, with only dozens of individuals estimated to be on each island. Tuyama (1936) recorded the distribution of *C. grandicollum* in the Kiyose area and Okumura area (both in Chichi-jima Island) in the early twentieth century, but the population has now disappeared from both areas. Accordingly, the species is classified as “critically endangered” on the Japanese Red List of vascular plants (Ministry of the Environment, 2020) and is recognized as one of the most in need of conservation in the Ogasawara Islands. Various anthropogenic impacts are likely to have decreased the population of *C. grandicollum* since human settlement on the islands. Ono (1998) stated that *C. grandicollum* populations sustained browsing damage by feral goats, but the details of the population status are still unclear.

The aim of this study was to provide a better understanding of the status of *C. grandicollum* and identify the

*FIGURE 1* Photographs of *Crepidiastrum grandicollum* status. (a) A large individual of *C. grandicollum*, (b) an exclusion net set around Population A in 2004, (c) an introduced honeybee (*Apis mellifera*) visiting flowers of *C. grandicollum*, and (d) larvae of *Spodoptera litura* feeding on *C. grandicollum* in Population A (the black particles are larval feces)
threats to this critically endangered species by describing the state of its populations and evaluating the impacts of goat browsing via a 5-year survey.

2 | MATERIALS AND METHODS

The oceanic Ogasawara Islands are located approximately 1,000 km south of Tokyo. The geology of the islands consists of mainly volcanic rocks and the islands appeared above sea level several million years ago (Kaizuka, 1977). The subtropical climate of the islands is moderately dry with a mean annual temperature of 23.4°C and an average annual precipitation of 1,271 mm during 1990–2019 at Chichi-jima Weather Station (Japan Meteorological Agency, 2020). The archipelago consists of more than 50 islands, and Chichi-jima Island is one of the largest (24 km², 326 m a.s.l). Because of the dry climate, vegetation is dominated by short dry forests and grasslands, and there are many exposed rocky areas.

I surveyed two C. grandicollum populations (A and B) on Chichi-jima Island. The specific locations of these populations are not reported here in the interest of concealing their specific habitat. There was no known population on Chichi-jima Island other than the two populations in this study, which occupied an area of less than 100 m² each. The habitats of the two populations are both in rocky areas with sparse soil. To monitor population dynamics, each individual was identified by attaching numbered DYMO tape with wire. Because these identification labels can be blown away by strong wind, I drew maps by hand that indicate the locations of individuals. Survival, the number of rosettes per individual, the number of rosette leaves, the number of flowers and feeding damage were surveyed every November from 2002 to 2006. The feeding damage caused by moth larvae was distinguished by small bite marks and feces. The number of recorded flowers is somewhat underestimated because the survey period (about 10 days) was shorter than the flowering period of the species and therefore underdeveloped flower buds or previously dropped flowers may not be detected. But, the survey was conducted at the peak of flowering, and we recorded countable buds and finished flowers that had not been dropped as much as possible, so I was able to get a general trend in individual flowering volume. In the first survey in 2002, especially, the timing of the survey was too early to collect data on the number of flowers per individual and the proportion of reproductive individuals in Population A. I also observed flower visitors for 350 min in total during 2001 and 2005 in the two populations. After the annual population monitoring, I searched for undiscovered individuals within a range of approximately 10 m around the population.

Population A had no exclosure when I started the survey. Because Population A was in a place where short pines (Pinus luchuensis) grow sparsely (Figure 1b) and was probably difficult for goats to physically penetrate or to find the species. C. grandicollum would have survived without intensive damage by the goats before the exclosure was set up. An exclusion net surrounding Population A was set up by the Ministry of the Environment in November 2004 just before the survey (Figure 1b). Population B had been surrounded by an electric fence to exclude feral goats since 2000, which provided an experiment for this research project, but the fence was removed in November 2004 just after the survey because the research project had been completed. This removal was required by the Ministry of the Environment because the permit to install the exclosure in the Ogasawara National Park had expired.

3 | RESULTS

In Population A, the number of individuals had increased in 2003 and 2004 but had slightly decreased in 2005 and 2006. In Population B, the number of individuals had increased in 2003 and 2004 when the population was surrounded by the electric fence, but had greatly decreased from 17 individuals to one individual in 2005, when the fence was removed, and remained unchanged in 2006 (Figure 2). In the protected period after setting up the exclusion net around Population A, many small-sized individuals were found, whereas large individuals were dominant in Population B before the exclosure was removed (Figure 3). Figure 4 shows the annual dynamics of the number of rosette leaves in relatively large individuals (more than four rosette leaves in 2002) in both populations. Mean number of rosette leaves in these individuals increased from 10.4 in 2002 to 15.4 in 2006 in
Population A, but it decreased from 19.3 in 2002 to 2.3 in 2005 in Population B because most individuals had disappeared, probably as a result of browsing by goats. Only a few recruitments were found outside the known range in either population throughout the 5 years of the study.

The proportion of reproductive individuals in Population A was approximately 20–60%, whereas the previous high reproductive rate (88% in 2002 and 91% in 2003) had decreased to zero in Population B after the fence was removed (Figure 5). Regarding the frequency distribution of the number of flowers, many flowers were seen in 2004 and 2005 after the exclosure was installed around Population A, whereas there were some individuals that produced many flowers (maximum 1,019 flowers per individual) by 2004 in Population B before removal of the exclosure (Figure 6). I observed introduced honeybees (*Apis mellifera*, Figure 1c) 15 times and alien ants *Technomyrmex brunneus* visiting flowers during a total of 350 min of observation.

The proportion of goat damage, which was confirmed by browsing signs on leaves or stems, was 60.0% in 2002, 27.6% in 2003 and 0% in 2004 after the exclusion net had been set around Population A. However, no damage was detectable in Population B because most individuals that appeared to have been grazed after the exclosure removal had disappeared (Figure 7). If the cause of these losses was browsing by goats, the proportion of goat damage increased to 94.1% (16 out of 17 individuals) in 2005 in

**FIGURE 3** Distribution of the number of rosette leaves for the protected period in (a) Population A and (b) Population B

**FIGURE 4** Annual dynamics in the number of rosette leaves of large individuals (more than four leaves in 2002) in (a) Population A and (b) Population B. The different marks represent different individuals. An individual with zero leaves is a dead individual. Arrows indicate the timing of installation of exclosure in Population A and removal of exclosure in Population B

**FIGURE 5** Proportion of reproductive individuals of *Crepidiastrum grandicollum*. *The number of reproductive individuals in 2002 may be underestimated in Population A. Arrows indicate the year of installation of exclosure before the 2004 survey in Population A and removal of exclosure after the 2004 survey in Population B
Although goat-related damage disappeared in Population A, feeding damage by *Spodoptera litura* (Lepidoptera) was observed in eight individuals (26.7%) in 2005 (Figure 1d) and three of these individuals died the next year.

4 | DISCUSSION

The population dynamics before and after the establishment and removal of the exclosures suggested that browsing by feral goats was a major threat to *C. grandicollum*. In Population B, most of the individuals were damaged by goats after the electric fence was removed (this population is protected today by a large exclusion fence that was set up by the government in 2012). In contrast, Population A remained present even before the fence was installed in 2004 to some extent and did not show a large increase as Population B did after the installation of the fence (Figure 2). This may be because the habitat was bushy (Figure 1b), rather than the more suitable open land. In addition, Typhoon No. 14 YAGI, which hit Ogasawara Islands in September 2006 and had a great impact on vegetation (Abe et al., 2020), is considered to be another explanation. The decline of the proportion of reproductive individuals in 2006 (Figure 5) would be, in part, for the same reason. The population in the enclosure was stable, but there were only a few individuals outside it (maximum eight individuals in 2006), and I conclude that *C. grandicollum* could not expand outside of the enclosure. The description of *C. grandicollum* in the literature indicates that the length of the stem below the leaves reaches 20 cm after it has grown for many years (Satake, Hara, Watari, & Tominari, 1989), but there were no such individuals present on Chichi-jima Island, and all were smaller individuals. It is estimated that there are several hundred feral goats on Chichi-jima Island (Toyoda, 2003) and the eradication of goats is necessary to avoid the extinction of *C. grandicollum*. Browsing by alien animals has considerable impacts on insular endangered plants, and all of these animals have been reported to be a substantial threat (Abe et al., 2008b; Jusaitis, 2005; Mauchamp, Aldaz, Ortiz, & Valdebenito, 1998). Furthermore, I found that *C. grandicollum* was subject to feeding damage by larvae of *S. litura*, a generalist moth that feeds on a wide variety of plant species (Ahmad, Ghaffar, & Rafiq, 2013). *S. litura* is common in the Ogasawara Islands and has also occurred on the endangered tree *Morus boninensis* (Ohbayashi, 2015). This also suggests that enclosure is not enough to conserve remaining populations. The damage by moth larvae during the survey period was predominant only in 2005, so I conclude that the intensity of moth damage varies greatly from year to year. However, once a high proportion of moth damage occurs, there is concern that it will be the final trigger for extinction because of the present critical status of
C. grandicollum. The use of insecticides is, however, unrealistic because S. litura has acquired high resistance to insecticides (Kranthi et al., 2002; Sreelakshmi, Mathew, Juralikrishna, & Paul, 2017) and because of the risk of non-target impacts on other endemic insects. These factors suggest that immediate eradication of the moth is difficult. Moreover, accumulation of harmful genes is progressing in critically endangered species in Ogasawara, including in C. grandicollum (Hamabata et al., 2019), and decreased genetic diversity may lead to reduced defensive ability against herbivores (Sato, 2018). Although protection of the natural habitat is a basic method of species conservation, in the case of C. grandicollum, population restoration in novel habitats is necessary to avoid insect damage and to prevent erosion of genetic diversity (IUCN/SSC, 2013).

Flowers of C. grandicollum were visited by alien insects during this survey. Because the native flower visitors have disappeared from Chichi-jima Island as a result of predation by the invasive green anole Anolis carolinensis (Abe, Kato, et al., 2011a; Abe, Makino, & Okochi, 2008a), the native flower visitors are unknown. Among the observed visitors in this study, introduced honeybees had pollen deposited on their bodies (Figure 1c), so I conclude that pollen dispersal of C. grandicollum is dependent on introduced honeybees. Although there are many examples in the world where alien species become one of the main pollinators (e.g., Junker, Bleil, Daehler, & Blüthgen, 2010; Morales & Aizen, 2006), I consider this case to be a clear rescue effect by an alien pollinator species, albeit with the problem of evolutionary noise for endemic flowers because the native flower visitors have already disappeared. The seed production is unclear because I did not survey it, but because the recruitment of many small individuals was observed after installation of the exclosure around Population A, natural regeneration is possible to some extent. Because C. grandicollum can start reproducing even from a small size, it seems that there will be no major obstacles to the immediate flowering and fruiting stages.

The endemic endangered C. grandicollum is still in a critical situation even though various endangered species conservation measures are being implemented in the Ogasawara Islands. Alien species interacted both negatively and positively with this species, but the protection of remaining habitats has been shown to be inadequate for the successful conservation of C. grandicollum. As long as goats exist, it is hopeless to spread the population outside the exclosure, and even if the population is protected by exclosure, persistence is not guaranteed due to other disturbances such as insect damage and typhoons. To mitigate the extinction risk, eradication of feral goats and population restoration in novel habitats would be necessary. Because the eradication of goats and creation of novel populations will take time to achieve, genetic analysis for prioritization and ex-situ conservation will also be important conservation options as measures to prevent extinction in the meantime.

ACKNOWLEDGMENTS
Our field survey was approved by the Ministry of the Environment and Forest Agency. Takaya Yasui and Kat-suyuki Wada provided useful field information. This study was partially supported by the Global Environment Research Fund (F-51). I thank Clio Reid, PhD, from Edanz Group (https://en-author-services.edanzgroup.com/) for editing a draft of this manuscript.

ORCID
Tetsuto Abe https://orcid.org/0000-0002-4726-7795

REFERENCES
Abe, T., Kato, Y., Wada, K., Makino, S., & Okochi, I. (2011a). Alien pollinator promotes invasive mutualism in an insular pollination system. Biological Invasions, 13, 957–967.
Abe, T., Makino, S., & Okochi, I. (2008a). Why have endemic pollinators declined on the Ogasawara Islands? Biodiversity and Conservation, 17, 1465–1473.
Abe, T., Tanaka, N., & Shimizu, Y. (2020). Outstanding performance of an invasive alien tree Bischofia javanica relative to native tree species and implications for management of insular primary forests. PeerJ, 8, e9573.
Abe, T., Wada, K., & Nakagoshi, N. (2008b). Extinction threats of a narrowly endemic shrub, Stachyurus macrocarpus (Stachyuraceae) in the Ogasawara Islands. Plant Ecology, 198, 169–183.
Abe, T., Yasui, T., & Makino, S. (2011b). Vegetation status on Nishi-Jima Island (Ogasawara) before eradication of alien herbivore mammals: Rapid expansion of an invasive alien tree, Casuarina equisetifolia (Casuarinaceae). Journal of Forest Research, 16, 484–491.
Ahmad, M., Ghaffar, A., & Rafiq, M. (2013). Host plants of leaf worm, Spodoptera litura (Fabricius) (Lepidoptera: Noctuidae) in Pakistan. Asian Journal of Agriculture and Biology, 1, 23–28.
Atkinson, I. A. E. (1989). Introduced animals and extinctions. In D. Western & M. C. Pearl (Eds.), Conservation for the twenty first century (pp. 54–69). New York, NY: Oxford University Press.
Brower, L., & van Buren, D. (1997). Insular endemic plants lack defenses against herbivores. Conservation Biology, 11, 1249–1254.
Carlquist, S. (1974). Island biology. New York, NY: Columbia University Press.
Caujapé-Castells, J., Tye, A., Crawford, D. J., Santos-Guerra, A., Sakai, A., Beaver, K., ..., Kueffer, C. (2010). Conservation of oce-anic Island floras: Present and future global challenges. Perspectives in Plant Ecology, Evolution and Systematics, 12, 107–129.
Chiba, S. (2010). Invasive non-native species’ provision of refugia for endangered native species. Conservation Biology, 24, 1141–1147.
Couchamp, F., Chapuis, J. L., & Pascal, M. (2003). Mammal invaders on islands: Impact, control and control impact. *Biological Reviews*, 78, 347–383.

Fernández-Lugo, S., Arévalo, J. R., de Nascimento, L., Mata, J., & Bermejo, L. A. (2013). Long-term vegetation responses to different goat grazing regimes in semi-natural ecosystems: A case study in Tenerife (Canary Islands). *Applied Vegetation Science*, 16, 74–83.

Hamabata, T., Kinoshita, G., Kurita, K., Cao, P. L., Ito, M., Murata, J., Makino, T. (2019). Endangered Island endemic plants have vulnerable genomes. *Communications Biology*, 2, 224.

Hamann, O. (1975). Vegetation changes in the Galápagos Islands during the period 1966-1973. *Biological Conservation*, 7, 37–59.

Hata, K., Kohri, M., Morita, S., Hiradate, S., & Kachi, N. (2014). Complex interrelationships among aboveground biomass, soil chemical properties, and events caused by feral goats and their eradication in a grassland ecosystem of an Island. *Ecosystems*, 17, 1082–1094.

IUCN/SSC. (2013). *Guidelines for reintroductions and other conservation translocations. Ver. 1.0.* Gland: IUCN Species Survival Commission.

Japan Meteorological Agency. (2020). https://www.jma.go.jp/jma/index.html. Accessed April 15, 2020 (in Japanese).

Junker, R. R., Bleir, R., Daehler, C. C., & Blüthgen, N. (2010). Intra-floral resource partitioning between endemic and invasive flower visitors: Consequences for pollinator effectiveness. *Ecological Entomology*, 35, 760–767.

Jusaitis, M. (2005). Translocation trails confirm specific factors affecting the establishment of three endangered plant species. *Ecological Management and Restoration*, 6, 61–67.

Kaizuka, S. (1977). Ogasawara no tiki to tishitsu [Topography and geology of the Ogasawara Islands]. *Ogasawara Kenkyu-Nenpo*, 1, 29–34 (in Japanese).

Kier, G., Kreft, H., Lee, T. M., Jetz, W., Ibisch, P. L., Nowicki, C., Barthlott, W. (2009). A global assessment of endemism and species richness across Island and mainland regions. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 9322–9327.

Kranthi, K. R., JadHAV, D. R., Kranthi, S., WanJari, R. R., Ali, S. S., & Russell, D. A. (2002). Insecticide resistance in five major insect pests of cotton in India. *Crop Protection*, 21, 449–460.

Mauchamp, A., Aldaz, I., Ortiz, E., & Valdebenito, H. (1998). Threatened species, a re-evaluation of the status of eight endemic plants of the Galápagos. *Biodiversity and Conservation*, 7, 97–107.

Ministry of the Environment. (2020). Red List. https://www.env.go.jp/nature/kisho/hozen/redlist/index.html. Accessed April 15, 2020 (in Japanese).

Morales, C. L., & Aizen, M. A. (2006). Invasive mutualisms and the structure of plant-pollinator interactions in the temperate forests of north-West Patagonia, Argentina. *Journal of Ecology*, 94, 171–180.

NüRk, N. M., Atchison, G. W., & Hughes, C. E. (2019). Island woodiness underpins accelerated disparification in plant radiation. *New Phytologist*, 224, 518–531.

Ohbayashi, T. (2015). Occurrence of *Spodoptera litura* (Fabricius) (Noctuidae, Xyleninae) on *Morus boninensis* in Chichijima Island of the Ogasawara (Bonin) islands. *Japan Heterocerists’ Journal*, 274, 613–615 (in Japanese).

Ono, M. (1991). The flora of the Bonin (Ogasawara) islands: Endemism and dispersal modes. *Aliso*, 13, 95–105.

Ono, M. (1998). Conservation of the endemic vascular plant species of the Bonin (Ogasawara) islands. In T. F. Stuessy & M. Ono (Eds.), *Evolution and speciation of Island plants* (pp. 169–180). New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511721823.012

Osawa, T., Hata, K., & Kachi, N. (2016). Eradication of feral goats enhances expansion of the invasive shrub *Leucaena leucocephala* on Nakoudo-jima, an oceanic Island. *Weed Research*, 56, 168–178.

Satake, Y., Hara, H., Watari, S., & Tominari, T. (1989). *Wild flowers of Japan: Woody plants II*. Tokyo: Helbonsha Ltd (in Japanese).

Sato, Y. (2018). Associational effects and the maintenance of polymorphism in plant defense against herbivores: Review and evidence. *Plant Species Biology*, 33, 91–108.

Sax, D. F., & Gaines, S. D. (2008). Species invasions and extinction: The future of native biodiversity on islands. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 11490–11497.

Shinobe, S., Uchida, S., Mori, H., Okochi, I., & Chiba, S. (2017). Declining soil Crustaceae in a world heritage site caused by land nemertean. *Scientific Reports*, 7, 12400.

Simbaña, W., & Tye, A. (2009). Reproductive biology and responses to threats and protection measures of the total population of a critically endangered Galápagos plant, *Linum cratericola* (Linaceae). *Botanical Journal of the Linnean Society*, 161, 89–102.

Sreelakshmi, P., Mathew, T. B., Juralikrishna, P., & Paul, A. (2017). Insecticide resistance in field populations of tobacco caterpillar, *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae). *Entomon*, 42, 41–46.

Sugiura, S. (2009). Seasonal fluctuation of invasive flatworm predation pressure on land snails: Implications for the range expansion and impacts of invasive species. *Biological Conservation*, 142, 3013–3019.

Toyoda, T. (2003). *Flora of Bonin Islands* (2nd ed.). Kamakura: Aboc-sha (in Japanese).

Tuyama, T. (1936). *Plantæ Boninenses Novæ vel Criticæ*. Tókyó: Heibonsha Ltd.

How to cite this article: Abe T. Impacts by feral goats on critically endangered *Crepidiastrum grandicollum* (Compositae) endemic to the Ogasawara Islands. *Plant Species Biol.* 2021;36: 361–367. https://doi.org/10.1111/1442-1984.12314