

Putative Koala Retrovirus-Associated Diseases in the Japanese Captive Koala (*Phascolarctos cinereus*) Population

TETSUYA IMANISHI 

JAZA Species Coordinator for Koala, Nagoya Higashiyama Zoo,
3-70 Higashiyama-motomachi Chikusa-ward Nagoya-city, 464-0847, Japan

ABSTRACT. Japan began housing koalas (*Phascolarctos cinereus*) in 1984, increasing from six individuals in 1984 to a peak of 96 koalas in 1997. However, the number of koalas has almost halved since and as of 2020, 54 koalas remain in zoos in Japan. Although records of 330 koala deaths have been accumulated over 37 years, there have been no comprehensive reports on the relationship between the causes of death and koala retrovirus (KoRV) in the Japanese captive population. Based on the koala studbook updated by the Japanese Association of Zoos and Aquariums, we have investigated causes of death in the Japanese captive koala population. The most common cause of death was joeys falling. When combined with stunted joey growth, one-third of the koalas died within a year of birth. Deaths due to malignant neoplasms and opportunistic infections cannot be directly associated with KoRV infection because no test for KoRV had been performed before or during disease onset. It is suspected that KoRV may be associated with deaths due to the large number of cases of neoplasms, which accounted for 16.4% of all deaths.

Introduction

Captive koala (*Phascolarctos cinereus*) breeding began in Japan when three zoos introduced six koalas from Australian zoos in 1984. The number of koala individuals and institutions increased subsequently through further imports and reproduction. A total of 81 koalas have been imported so far, all but one from Australia. Eight koalas have been exported overseas to the United States, the United Kingdom, Australia and other countries. A total of 311 koalas have been born in Japan, and 330 koalas have died since 1984. After reaching a peak of 96 individuals in 1997 and 10 institutions in 1998, the number of koalas has halved in 15 years. As of the end of December 2020, 54 koalas were living at seven institutions in Japan.

The purpose of this study was to investigate the more than 300 cases of koala deaths that occurred in Japanese captive populations from the point of view of KoRV, which

is thought likely to cause immunosuppression and malignant neoplasms (Tarlinton *et al.*, 2005; Quigley *et al.*, 2018; Zheng *et al.*, 2020), and to search for a relationship between KoRV infection and mortality.

The Japanese koala studbook, started in 1984 and updated by the Japanese Association of Zoos and Aquariums in 2020, contains information on a total of 392 koalas, including 331 koalas that were born in Japan and 330 koalas that died in Japan. The results categorizing these koalas by cause of death are shown in Table 1. In cases where two or more causes of death were recorded together, malignant neoplasms were prioritized as the cause of death.

Deaths of 102 joeys less than 1 year old accounted for 30.9% of all deaths. Of these deaths, 66 cases were due to “joey falling,” and 36 cases were due to “stunted growth of joey” including five cases of joey loss. About one third of the 311 koalas born in Japan died before the age of one year old. Although this is a very high mortality rate, the European

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ORCID ID: Tetsuya Imanishi <https://orcid.org/0000-0003-0087-9214>

Corresponding author: Tetsuya Imanishi t.imanishi.vm@city.nagoya.lg.jp

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