of mast cells present was significantly greater in adult than in juvenile animals. Amongst adult groups, mast cell numbers were greater in follicular and luteal phase animals than in oestradiol-treated animals. Changes in total mast cell number amongst adult animals were not reflected in changes to the number of epithelial mast cells. Mast cell populations displayed two aspects of anisotropy irrespective of reproductive status, where (i) cells were predominantly located in the epithelial tissue and/or in that region of connective tissue adjacent to the basement membrane and (ii) cells often appeared as aggregations of three or more cells per disector volume.

Mast cell density was significantly lower in those animals exposed to endogenous and exogenous oestradiol than in lactationally and seasonally anoestrous animals. This may be attributed to increases in total cul-de-sac volume. Electron microscope studies showed that the volume fraction (V_v) of granules in mast cells was greater in lactationally and seasonally anoestrous animals than in luteal phase animals.

In conclusion, the density of mast cells in the cul-de-sac of the female brushtail possum shows changes after exposure to oestradiol. This was not related to microbial invasion, but may be due to changes in tissue volume, or to some unidentified stimulus.

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(Manuscript received 06.09.2004)

Thesis Abstract: Investigation of a Decision-support Framework for the Sustainable Development of the South American Quarrying Industry: An Application of the Quadruple Bottom Line

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Abstract of a thesis submitted for the Degree Doctor of Philosophy, University of New South Wales, New South Wales, 2004

This research examines the connection between the implementation of strategies addressing the environmental, social, economic and governance aspects of mining (what the author recognises as the quadruple bottom line of sustainable development) and the sustainability of the South American quarrying industry.

The project included the analysis of the quarrying industry of the capital cities of Colombia, Chile and Ecuador, as representative case studies of South America. Fieldwork in these cities involved interviewing stakeholders, visiting quarries, observing behaviour, and testing knowledge and understanding about sustainable quarry development. The information gathered was then combined with the information provided by national mining registers to identify the issues that inhibit the sustainability of quarrying in Colombia, Chile and Ecuador.

In parallel to the fieldwork, an analysis was conducted of specific environmental, social, economic and governance aspects of the minerals industries of various countries. These countries included Canada, the United States, Panama, Dominican Republic, Cuba, Brazil, Spain, England, South Africa, Australia, China and the Philippines. This investigation confirmed the connection between the implementation of strategies addressing the quadruple bottom line of sustainable development and the

sustainability of the minerals industry.

A combination of three qualitative analysis methods namely, successive approximation, illustrative method and ideal types method, has been used in the development of specific sustainable development strategies for the South American quarrying industry. These strategies are presented as the 'decision-support framework for the sustainable development of the quarrying industry of South America'. This framework focuses on the implementation of strategies dealing with the quadruple bottom line of sustainable development. The key areas addressed in these strategies are: a regulatory framework for quarrying, special considerations for the small-scale and artisanal quarrying industry; environmental strategies for larger quarrying companies; the role of the quarrying industry's stakeholders; and additional environmental recommendations.

The research undertaken for this thesis was able to fill significant knowledge gaps about the unsustainable character of the South American quarrying industry. It was found that the key sustainability issues faced by the South American quarrying industry are: the marginal and undercapitalised character of this industry; the weaknesses of the regulatory framework for quarrying, the environmental and social impacts of quarrying operations; and the effects of quarrying in urban areas. Corruption and armed conflict were also found to be important limitations of the industry. It was confirmed that the South American quarrying industry is not based on a framework that reflects the consideration of the quadruple bottom line of sustainable development.

The thesis concluded that the quarrying industry of South America is not ready to achieve its sustainable development and to contribute to the sustainability of other economic activities of these countries. Further research, particularly in relation to small-scale and artisanal quarrying operations; implementation of cleaner production and eco-efficiency in quarrying; recycling and reuse of quarry resources; and quarry development in urban areas is recommended.

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(Manuscript received 02.08.2004)