

Mammal roadkill and mitigation measures of freeway in Taiwan

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The Freeway Bureau started the daily freeway shoulder roadkill survey which is conducted by trained road cleaners since 2009. The total length of the freeway is about 1000 km and the survey has recorded 65,400 roadkills belonging to 138 species of vertebrates in the past 10 years. Small birds (64%), dogs and cats (23%) are the most common groups of roadkills on freeway. The medium-sized mammals (1%), including *Paguma larvata*, *Lepus sinensis formosus*, *Melogale moschata subaurantiac*, *Manis pentadactyla pentadactyla*, *Prionailurus bengalensis* and *Muntiacus reevesi micrurus*, etc., are group of special concern because of most of the members are protected species and freeway increasing not only the mortality risk but also habitat fragmentation.

To reduce the roadkill rate of medium-sized mammals, we identified roadkill hotspots and evaluated the feasibility of modifying the existing crossing structure for target species. From 2012 to 2018, more than 20 km of fences and 20 wildlife crossings that modified from the existing bridges, culverts and tunnels were installed at Freeway No.3. We evaluated the effectiveness of the mitigation measures by comparing the mortality rate before and after the mitigation and using camera traps monitoring the use of target species. The results show the mitigation measures reduced medium-sized mammal roadkill by 92%. *Paguma larvata* is the most common roadkilled medium-sized mammals on the freeway and thus our major target species. Camera traps data shows that the mitigation measures successfully guide *Paguma larvata* from the roadside through the wildlife crossing structures to the other side of the freeway. The first tunnel crossing of freeway showed an increasing and high *Paguma larvata* crossing rate relative to local abundance. *Melogale moschata subaurantiac*, *Lepus sinensis formosus*, *Prionailurus bengalensis*, *Manis pentadactyla pentadactyla* and *Herpestes urva formosanus* were also recorded using some of the mitigation structures.

The Freeway Bureau has established effective roadkill mitigation measures for medium-size mammals. Similar measures were also applied on the structures where the freeway cross the important corridor of *Prionailurus bengalensis* to enhance habitat connectivity.

Keywords : roadkill survey, medium-sized mammal, wildlife crossings, fence, Masked palm civets, *Paguma larvata*

台灣國道中型哺乳動物路殺與減輕對策

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交通部高速公路局自 2009 年開始執行全國道每日雙向路肩路殺動物調查，調查工作由經過訓練的國道清潔人員負責，全長約 1000 公里的國道至 2018 年初已調查到約 138 種 6 萬 5 千筆動物的路殺紀錄，主要類群為佔全部紀錄 64% 的小型鳥類和 23% 的貓狗，而過去 10 年間高公局已分別針對紫斑蝶、中型哺乳動物、鷺鷥和貓狗進行過路殺減輕改善作為或試驗研究。路殺中型哺乳動物包括白鼻心、台灣野兔、鼬獾、台灣獼猴、穿山甲、石虎和山羌等種類，大部分均為保育類物種，且可能對用路人安全造成威脅，因此是高公局優先關注的類群，因部份國道以非高架形式穿過淺山森林環境，且兩側路權範圍內長期保護良好，因此形成中型哺乳動物路殺熱點。國道由於結構形式、寬度和車流量等因素，除具飛行能力物種外幾乎不可能成功穿越路面，但前期調查結果顯示有部份下方箱涵管涵已有動物利用作為穿越國道路徑，因此高公局自 2012 年開始即嘗試以設置防護導引網配合既有國道結構物改善作為動物通道的方式進行中型哺乳動物路殺熱點的改善，至 2018 年止已經陸續於國道 3 號新竹寶山、苗栗通霄、南投草屯和嘉義民雄等熱點路段完成總長超過 20 公里的防護網和 20 處以上的動物通道改善工作。改善流程包含熱點分析、現地結構物勘查和可行性分析、改善設計施工和成效監測等階段，配合各次不同的改善需求也陸續完成不同形式的改善設施物如防護網、導引網、動物通道出入口、棧橋和多功能跨越橋設計和標準圖建置。

中型哺乳動物路殺改善作為的成效主要藉由分析改善前後國道路殺數量減少比例，以及利用自動相機監測目標物種利用改善設施的情形兩方面來評估。分析改善最早且監測資料最完整的民雄和關西路段資料顯示改善後中型哺乳動物路殺密度下降了 92%。自動相機監測結果顯示大部分的改善設計均有目標物種穩定利用。白鼻心是路殺數量最多的中型哺乳動物，也是各處動物通道主要利用的物種，通常在改善作為完成後數天至數月內即會開始出現，最早完成的民雄動物通道監測資料顯示白鼻心穿越率有每年增加的趨勢且高於週邊環境的族群豐度。鼬獾、台灣野兔、石虎、穿山甲和食蟹獾亦有穩定利用動物通道的紀錄。

高公局在建立中型哺乳動物路殺熱點改善機制後，亦進一步嘗試降低國道造成的淺山棲地切割影響，利用地理資訊系統分析將國道沿線棲地敏感程度和重要廊道位置，針對主要切割瓶頸路段積極改善國道高架橋或車行箱涵等結構物，增設跨橋和動物坡道等設施，以連結國道兩側棲地，相關改善工作目前亦有良好成效。

關鍵字：路殺調查、中型哺乳動物、動物通道、防護網、白鼻心