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測量打樁噪音導致的緊迫以及對海豚健康之影響

Measures of stress before and after pile-driving sound exposure and implications for cetacean health

楊瑋誠¹、陳琪芳²、任一凡³、周蓮香^{4*}

¹國立嘉義大學獸醫學系

²國立台灣大學工程科學及海洋工程學系

³遠雄海洋公園

⁴國立台灣大學生態學與演化生物學研究所

Wei-Cheng Yang¹, Chi-Fang Chen², I-Fan Jen³, Lien-Siang Chou^{1*}

¹Department of Veterinary Medicine, National Chiayi University

²Department of Engineering Science and Ocean Engineering, National Taiwan University

³Farglory Ocean Park

⁴Institute of Ecology and Evolutionary Biology, National Taiwan University
chouls@ntu.edu.tw

摘要

離岸風機為國家重要的再生能源政策，然而風機建設過程中的打樁噪音可能會對近距離內的白海豚造成聽力損傷與行為影響。因此施工階段亟須採取預防性措施、減輕衝擊措施與施工管制措施等以降低對生態之衝擊。本研究從生理面向來瞭解離岸風能開發對海豚的個體的可能衝擊。我們使用已建立的海豚聽力曲線與免疫反應之基準值進行噪音暴露與免疫生理的影響分析。結果發現於高音量（mean Lz-p = 160 dB re 1 μ Pa）之打樁噪音暴露 30 分鐘後其緊迫指數（包括皮質醇與細胞激素表現）與其他音量相比有顯著上升，低音量（mean Lz-p = 147 dB re 1 μ Pa）則與無音量無明顯差異。研究結果將可提供建立風機施工打樁噪音暴露管制標準的參考，並建議未來應進行長期監測白海豚在野外對離岸風機的行為反應來釐清開發對白海豚族群之生態衝擊。

關鍵詞：離岸風電、中華白海豚、噪音衝擊、施工管制措施、減輕衝擊

Abstract

Offshore wind power is the important renewable energy policy in our country. The Chinese white dolphins may be harassed by the construction and operation of an offshore wind farm. The noise impact of pile-driving is the most serious issue, immediate impacts on Chinese white dolphins include hearing threshold shift and behavioral response. Thus it is necessary to adopt precautionary approaches, noise reduction measures, and regulations of construction in order to minimize the impacts on Chinese white dolphins. In this study, the possible impacts of wind power development on Chinese white dolphins and the recommended mitigation strategy were analyzed in physiological aspect. The impact on immune function from noise exposure was analyzed using the established monitoring methods of immunological response. The result showed that the stress index (cortisol and cytokine gene expression) under pile-driving sound exposure in high SPL (average Lz-p = 160 dB re 1 μ Pa) for 30 min was significantly elevated from that in other sound levels. There was no significant difference in the change of stress index between low SPL (average Lz-p = 147 dB re 1 μ Pa) and control. Our findings can serve as important reference for decision making in drafting regulation of noise exposure level during pile driving. We suggest to take long term monitoring on dolphins' behavioral response to wind farm piling and operation in the field, in order to clarify the impact level to dolphins from offshore wind farms.

Keywords: offshore wind farm, *Sousa chinensis*, noise impact, noise reduction, impact mitigation