

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirements for the degree of Master of Science

**INVESTIGATION OF PREDATOR–PREY RELATIONSHIPS OF
BLACKTIP REEF SHARKS AT CHAGAR HUTANG TURTLE SANCTUARY
USING STABLE ISOTOPE ANALYSIS**

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2021

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The predator–prey relationship between marine predators, such as sharks, and their prey is an important association which helps to control the flow of nutrients and energy through the marine ecosystem and mediate the dynamics and structures of marine communities. To effectively preserve ecosystem balance and resilience in marine habitats, conservation measures must encompass holistic approaches which involve the protection of multiple species simultaneously. This makes it important to understand how different species interact and influence each other. The present study investigated the predator–prey interactions between blacktip reef sharks and their prey in Chagar Hutang Bay on Redang Island, Terengganu with special emphasis on their predation of turtle hatchlings. Stable isotope analysis (SIA) and stomach content observations were used to determine the proportional dietary compositions of the sharks at different times during the year, revealing the relative contributions of turtle hatchlings and other prey to the sharks' diets. Prior to collecting tissue samples from the blacktip reef sharks in the wild, laboratory experiments were conducted to determine the best methods to preserve and desiccate shark tissue samples for SIA

analysis. The contribution of turtle hatchlings to the sharks' diets differed significantly between different points of the year. During the monsoon season, turtle hatchlings contributed as little as 0% to the sharks' diets, whereas during the turtle nesting season they made up an average of 17% of their diets, with a maximum observed dietary contribution of 100%. The most common alternative shark prey were small, planktivorous fish, crustaceans, and small molluscs. Overall, the mean $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of shark fin across all three sampling seasons were -13.9‰ and 8.8‰ , respectively, while the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values for shark whole blood were -14.1‰ and 11.3‰ , respectively. It was concluded that during the turtle nesting season, hatchlings can be an important food source to blacktip reef sharks in Chagar Hutang Bay, with some juvenile sharks feeding exclusively on hatchlings for unknown periods of time. To reduce predation risks to and pressures on turtle hatchlings, conservationists should attempt to space out artificial hatcheries or hatchling releases and undertake the targeted protection of alternative shark prey.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Sarjana

**PENYIASATAN HUBUNGAN MANGSA–PEMANGSA
YU SIRIP HITAM DI SANTUARI PENYU CHAGAR HUTANG
MENGUNAKAN ANALISIS ISOTOP STABIL**

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Hubungan di antara spesies haiwan mangsa dan pemangsa marin, seperti ikan yu dan mangsanya, adalah penting dalam mengawal aliran nutrien dan tenaga di dalam ekosistem, dan mengantara dinamik dan struktur komuniti marin. Bagi memelihara keseimbangan dan daya ketahanan suatu habitat marin, pengurusan pemuliharaan habitat tersebut perlu menggunakan pendekatan menyeluruh yang menyasarkan pelbagai spesies sekaligus. Demikian, adalah penting bagi kita memahami bagaimanakah spesies haiwan yang berlainan berinteraksi dan mempengaruhi di antara satu sama lain. Kajian semasa telah menyiasat hubungan mangsa–pemangsa yu sirip hitam di Teluk Chagar Hutang, Pulau Redang, Terengganu, dengan memberi tumpuan khas kepada pemangsaan anak–anak penyu. Analisis isotop stabil (SIA) dan isi kandungan sistem penghadaman yu sirip hitam telah digunakan bagi menganggar sumbangan anak penyu dan spesies haiwan mangsa yang lain kepada diet yu sirip hitam pada waktu–waktu yang berlainan sepanjang tempoh kajian. Sebelum mengumpul sampel tisu yu sirip hitam di lapangan, kajian makmal telah dilangsungkan bagi menentukan kaedah preservasi dan pengeringan sampel tisu yu yang paling sesuai

bagi tujuan SIA. Sumbangan anak penyu kepada diet yu berbeza dengan ketara pada waktu-waktu berlainan sepanjang tahun. Pada musim tengkujuh, sumbangan anak penyu kepada diet yu adalah serendah 0%, manakala pada musim penyu bertelur purata sumbangannya adalah sebanyak 17% dan boleh mencapai 100%. Selain anak penyu, mangsa utama yu merupakan ikan planktivor bersaiz kecil, haiwan krustasea dan moluska kecil. Purata nilai $\delta^{13}\text{C}$ dan $\delta^{15}\text{N}$ sampel sirip yu sepanjang tempoh kajian adalah -13.9‰ dan 8.8‰ , manakala purata nilai $\delta^{13}\text{C}$ dan $\delta^{15}\text{N}$ darah yu adalah -14.1‰ dan 11.3‰ . Adalah disimpulkan bahawa anak penyu merupakan sumber makanan penting bagi yu pada musim penyu bertelur di Teluk Chagar Hutang, sehingga boleh menjadi penyumbang tunggal kepada diet yu bagi tempoh yang tidak diketahui. Bagi mengurangkan risiko dan meringankan tekanan pemangsa terhadap anak penyu, usaha pemuliharaan boleh menyasarkan penjarakan secukupnya di antara waktu pelepasan dan juga di antara tempat penetasan penyu tiruan, di samping pemuliharaan populasi haiwan-haiwan mangsa alternatif yu sirip hitam.