UNIVERSITI PUTRA MALAYSIA

ASSESSMENT OF MORPHOLOGICAL VARIATION OF MALAYSIAN *HALODULE* SPECIES COMPLEX;

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ASSESSMENT OF MORPHOLOGICAL VARIATION OF MALAYSIAN *HALODULE* SPECIES COMPLEX

By

NORHAPIZAH AHMAD NAZRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

February 2007

This thesis is dedicated to my beloved one…kanda

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

ASSESSMENT OF MORPHOLOGICAL VARIATION OF MALAYSIAN HALODULE SPECIES COMPLEX

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NORHAPIZAH AHMAD NAZRI

February 2007

Chairman: **Associate Professor Japar Sidik Bujang, PhD**

Faculty: **Science**

Halodule uninervis and *H. pinifolia* are widely distributed along the southwest, south and east coast of Peninsular Malaysia, Sabah and Sarawak. Eleven locations were selected for this study and each site has different habitat characteristics. Samplings and collections of *Halodule* plants were conducted from August 2002 until May 2004. From the study *Halodule* species occurred on various habitats and a variety of substrates; sand, coralline sand, coral degraded sand, loamy sand, calcareous sandy-mud, sandy-mud, mud and soft mud. They also grow in wide range of salinity (18-34‰) and depths (-1.5 to -7.0 m MSL). These species were found growing as a single pure population or exist in association with other seagrasses (e.g. *H. pinifolia*, *H. ovalis, H. minor, H. spinulosa, Halophila* species*, C. rotundata, C. serrulata, T. hemprichii* and *E. acoroides*), seaweeds (e.g. *Ulva reticulata, Acanthophora spicifera* and *Gracillaris* sp.) and fauna (e.g. fishes, echinodermata, cnidaria, mollusca and crustacea).

Halodule uninervis and *H. pinifolia* have the capability to adapt in different environments through changes in morphology. Plants on exposed site have short leaves with short erect stems while plants that are under shade and always in submerge condition have long leaves with long erect stems. In addition plants from an area of high sedimentation

also have long erect stems. Branching erect stems with roots at the nodes were found where the substrate is loose coralline sand. Results also showed that plants growing on substrate that contain mud tend to have wider leaves compared to plants on sand substrate. Studies found the types of substrate and spaces availability for the growth of plants have an affect on the morphological variation of rhizome internodes for both species. Leaf sheath morphology, pattern of leaf surfaces, and anatomical structures were not affected by habitat characteristics for both *H. uninervis* and *H. pinifolia*.

Laboratory culture studies on *H. uninervis* in different conditions, showed changes in morphological characteristics. The plants showed similar decrement in length of leaves (almost 50%) for different conditions (with cultures kept under the same amount of ambient light) suggest that light influence the leaf length characteristics. The leaves tend to be narrow for plants in natural substrate (3%) compared to artificial substrate (50%) suggesting that substrate types influenced the leaf width characteristics. Leaf tip morphology did not change among cultures.

Culture observation on *H. pinifolia* in laboratory condition showed that leaves tend to be narrow throughout the period of the study. Observation found that the leaf tip morphology of *H. pinifolia* changes under laboratory conditions. *Halodule pinifolia* exhibited the leaf tip morphology that belongs to *H. uninervis*.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGENALPASTIAN KE ATAS VARIASI MORFOLOGI SPESIES KOMPLEKS *HALODULE* DI MALAYSIA

Oleh

NORHAPIZAH AHMAD NAZRI

February 2007

Pengerusi: **Profesor Madya Japar Sidik Bujang, PhD**

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Halodule uninervis dan *H. pinifolia* boleh didapati di sepanjang barat daya, selatan dan pantai timur Semenanjung Malaysia, Sabah dan Sarawak. Sebelas lokasi telah dipilih untuk kajian ini dan setiap kawasan mempunyai ciri habitat yang berbeza. Persampelan spesies *Halodule* dijalankan dari Ogos 2002 hingga Mei 2004. Kajian mendapati spesies *Halodule* terdapat dipelbagai jenis habitat dan substrat; pasir, pasir berkarang, pasir serpihan karang, pasir loam, pasir lumpur bercengkerang, pasir lumpur, lumpur dan lumpur halus. Ia juga tumbuh pada julat kemasinan (18-34‰) dan kedalaman (-1.5 to –7.0 m MSL). Spesies ini di dapati tumbuh sebagai populasi tunggal atau tumbuh bersama spesies rumput laut yang lain (*H. pinifolia*, *H. ovalis, H. minor, H. spinulosa, Halophila* species*, C. rotundata, C. serrulata, T. hemprichii* and *E. acoroides*), rumpai laut (*Ulva reticulata, Acanthophora spicifera* and *Gracillaris* sp.) dan fauna (contoh: ikan, echinodermata, cnidaria, moluska and krustasia).

Halodule uninervis dan *H. pinifolia* mempunyai kebolehan untuk beradaptasi dalam persekitaran yang berlainan melalui perubahan pada morfologinya. Tumbuhan di kawasan yang terdedah mempunyai daun yang pendek berserta batang menegak yang

pendek manakala tumbuhan yang tumbuh di kawasan terlindung dan ditenggelami air mempunyai daun yang panjang berserta batang menegak yang panjang. Tumbuhan dari kawasan yang bersedimen tebal juga mempunyai batang menegak yang panjang. Batang menegak yang beranting dan mempunyai akar pada nodul dijumpai apabila tumbuhan tumbuh di atas substrat seperti pasir berkarang yang tidak padat. Kajian mendapati tumbuhan yang tumbuh di atas substrat yang mengandungi lumpur condong untuk memiliki daun yang lebar berbanding tumbuhan yang tumbuh di atas substrat pasir. Kajian mendapati jenis substrat dan ruang untuk tumbuhan tumbuh menyebabkan tindak balas variasi morfologi ke atas internod rizom untuk kedua-dua spesies yang dikaji. Morfologi seludang daun, corak sel permukaan daun dan struktur anatomi tidak dipengaruhi oleh ciri-ciri habitat untuk kedua-dua *H. uninervis* dan *H. pinifolia*.

Kajian kultur di makmal ke atas *H. uninervis* dalam keadaan yang terkawal, di dalam keadaan yang berbeza menunjukkan perubahan pada ciri morfologi. Pemendekkan daun adalah sama (hampir 50%) dalam keadaan yang berbeza (dimana kultur diletakkan di bawah pencahayaan yang sama) menunjukkan cahaya mempengaruhi pemanjangan daun. Helaian daun menjadi tirus apabila tumbuh di dalam keadaan bersubstrat semulajadi (3%) berbanding didalam substrat tiruan (50%) menunjukkan jenis substrat mempengaruhi pelebaran daun. Morfologi hujung daun tidak berubah di antara kultur.

Pemerhatian kultur *H. pinifolia* di dalam keadaan makmal yang terkawal menunjukkan daun menjadi semakin tirus sepanjang tempoh kajian. Pemerhatian mendapati morfologi hujung daun *H. pinifolia* berubah apabila dikultur secara terkawal di makmal.

Halodule pinifolia mempamerkan morfologi hujung daun yang menyerupai hujung daun *H. uninervis*.

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I certify that an Examination Committee has met on to conduct the final examination of Norhapizah Binti Ahmad Nazri on her degree thesis entitled "Malaysian *Halodule* Species Complex; Assessment on the Morphological Variations" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

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Date: 9 August 2007

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

NORHAPIZAH AHMAD NAZRI

Date: 25 June 2007

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