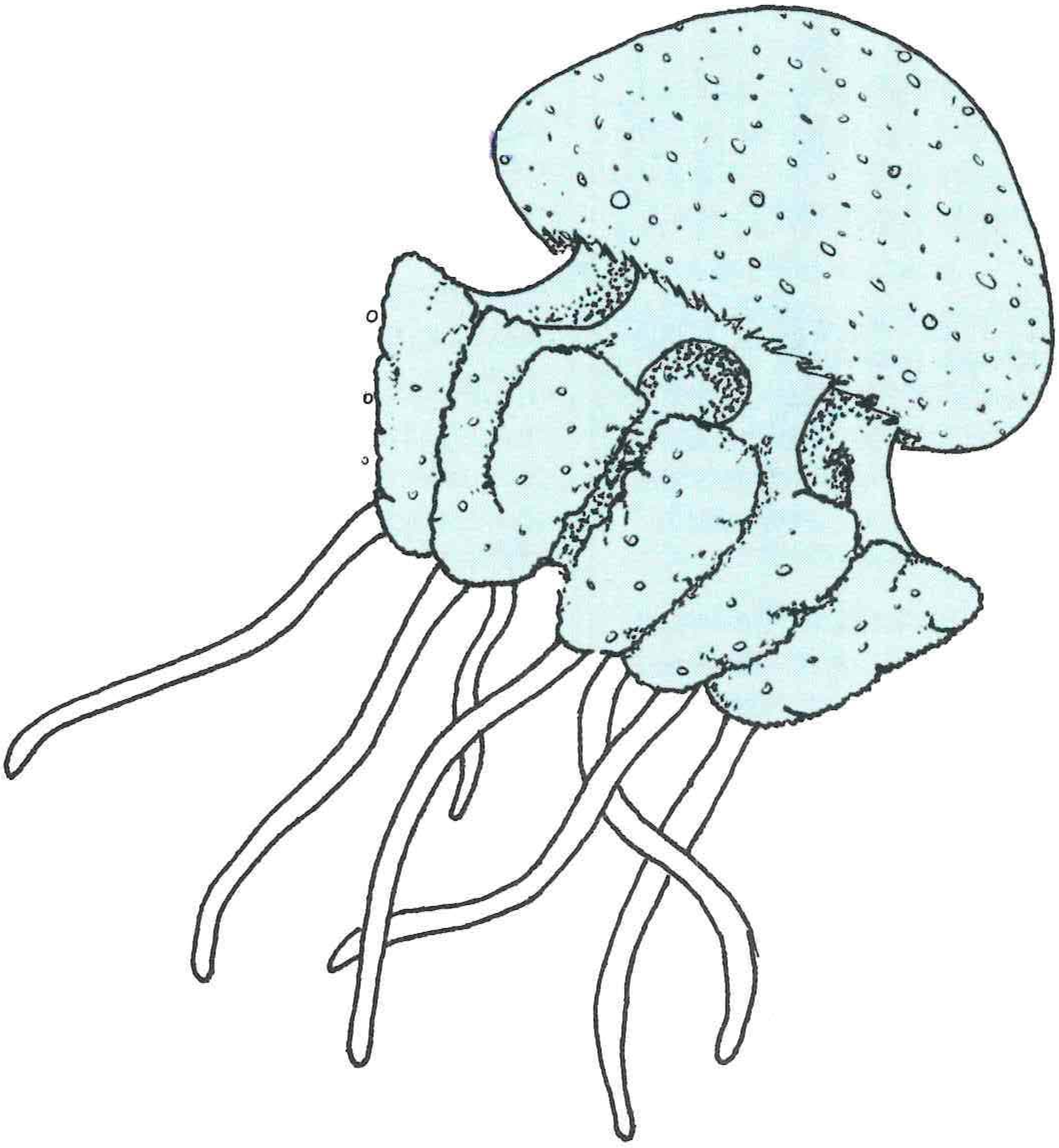
The Brown Jellyfish

(Phyllorhiza punctata)



in the Swan-Canning Estuary

Waterways Information No. 2

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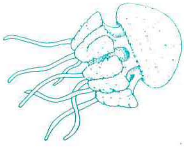
Swan River Trust, January 1990



The Brown Jellyfish *(Phyllorhiza punctata)* in the Swan-Canning Estuary

INTRODUCTION

Most people who have swum in the river have had the experience of bumping into a large jellyfish. Most prawn netters have searched through heaps of jellyfish for the occasional prawn, and anybody who has been boating in the lower estuary in summer has seen jellyfish in vast numbers.

Jellyfish have been part of the estuarine ecosystem for a long time. James Backhouse, who visited the Swan River Colony in the summer of 1837-8, reported seeing "multitudes of two species of jellyfish", one "brown in colour with spongy masses". Both *Phyllorhiza punctata* and *Aurelia aurita* can still be seen in their multitudes. This leaflet is about the brown jellyfish.

Jellyfish belong to the Class Scyphozoa within the Phylum Cnidaria. Other Cnidarian animals include sea anemones and corals, in the Class Anthozoa, and a group of inconspicuous marine animals and the freshwater Hydra in the Class Hydrozoa. In comparison with most other groups of animals, Cnidarians are structurally simple but their role in the function of some ecosystems is significant.

DISTRIBUTION WITHIN THE ESTUARY

How far upstream?

During summer, brown jellyfish 'medusae' (the free-swimming stage of the jellyfish lifecycle that most people recognise as jellyfish) may be seen as far upstream as Shelley Bridge in the Canning River and up to Garratt Road Bridge in the Swan River. It would be rare for them to extend much further upstream.

Their distribution depends on the salinity of the river water. Healthy swimming medusae are only seen when and where the salinity of the water is greater than 25 parts per thousand (ppt.). The salinity of sea water is about 35 ppt. The medusae are unable to live for long in lower salinities, and laboratory tests have shown that they cannot survive for more than a few hours in salinities less than 20 ppt.

Where do the jellyfish go in winter?

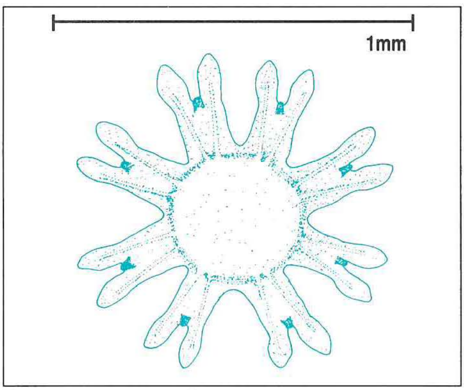
After the start of winter rains, runoff dilutes the marine water in the estuary, the salinity drops and the jellyfish probably die and sink or get washed out to sea.

THE JELLYFISH LIFE CYCLE

The free-swimming medusae are just one stage in a complex lifecycle. Mature medusae develop either as male or female. When they are sexually mature, they release eggs and sperm into the water. The fertilized eggs adhere to the mouth tentacles of the jellyfish and develop into small multicellular 'planula' larvae. This free-swimming stage eventually attaches to a firm surface and grows into a 'scyphistoma'.

The next stage in the lifecycle, the 'ephyra', is formed by budding off parts of the scyphistoma. A series of divisions form close to the top of the scyphistoma. Eventually the topmost division becomes complete and a free-swimming ephyra stage is released. Other ephyrae form from the divisions beneath the first. Each new ephyra is 1 - 3 millimetres across. These minute creatures grow into the familiar medusae, assuming the adult shape when they are about 10 millimetres across. Although the ephyrae make a swimming movement, they are mainly moved around by currents in the water.

The scyphistoma is so inconspicuous that it is very difficult to find in the estuary. However, since ephyrae can be found in the Canning estuary early in summer, and when the tide is low, it can be assumed that the scyphistoma are close by and can survive in the estuary throughout winter. Early in summer there are none of the very large brown jellyfish which can be seen in mid and late summer. This suggests that the medusae grow within the estuary from ephyrae which are released in early summer as soon as the salinity of the water is high enough to permit their survival.



Phyllorhiza punctata ephyra

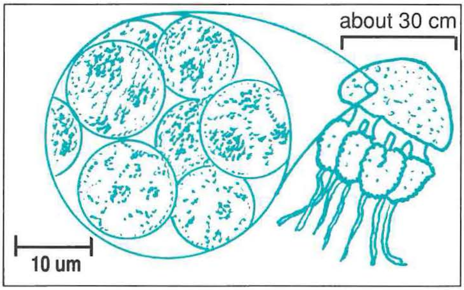
THE PLANT LIFE WITHIN

Why is the brown jellyfish brown?

A close look at a medusa shows that the brown colour is located very close to the outer surface of the animal and, in places, occurs in distinct strips This is especially clear on the underside of the bell. Closer examination with a microscope shows that the colour is located within microscopic single-celled plants growing within the cells of the animal. Zooxanthellae is a general name for plants of this type which grow in close association with marine animals. Most zooxanthellae are related to the Dinoflagellates, a group of organisms which usually occur as free-moving single cells but in some species have evolved this intimate relationship with marine animals. Many corals have associated zooxanthellae. This close relationship is often referred to as mutualism, a form of symbiosis, or living together.

Why get together?

Both the jellyfish and the zooxanthellae benefit from living together. The jellyfish is provided with food without actually consuming the plant cells. Plants are able to trap energy from sunlight and convert it into chemical energy. This process of photosynthesis provides the energy for plant growth. The zooxanthellae produce more organic material than they can use for their own growth. The excess is exuded by the plant cells and taken up and used by the cells of the jellyfish. It is not known how much this contributes to the food requirements of the jellyfish, but it could be a large proportion of the overall food need.



Zooxanthellae (highly magnified)

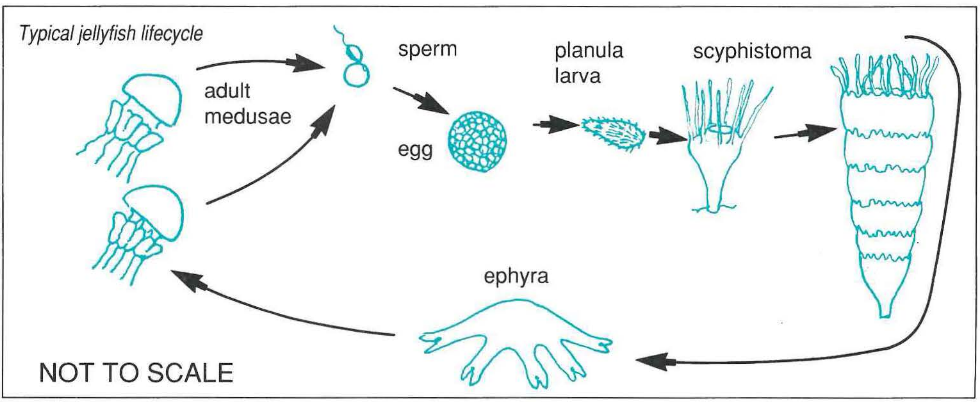
The zooxanthellae, in turn, are provided with a habitat enriched by the excretory products of the jellyfish. During late summer and autumn, when nutrient levels in the river water are low, jellyfish may have more plant material associated with them than occurs as free-living phytoplankton. The symbiotic relationship between the jellyfish and the zooxanthellae must make very efficient use of available nutrients.

Contributing to the food chain

All animals form part of a food chain, eating plants or animals and in many cases being eaten by other animals. It is not known if the jellyfish has any major predators in the Swan River. However, the brown jellyfish makes a significant contribution to the food chain in another way.

Plants carry out photosynthesis, releasing oxygen into their environment. Animals never release oxygen, but they use oxygen in the process of respiration which releases energy from their food.

During daytime in summer, the jellyfish - zooxanthellae combination operates as a plant, producing more oxygen by photosynthesis than is used by respiration. Although at night the situation is reversed, with both the animal and the plant cells using oxygen, the total effect over 24 hours is nett oxygen production. This means that more high-energy material is being produced by the organism than is being consumed. Surplus high-energy material is probably released into the water in the form of slimy secretions. Micro-organisms may use these dissolved organic compounds as an energy source and so the jellyfish contribute to the food chain.



THE PATCHY DISTRIBUTION OF BROWN JELLYFISH

Reaction to light

Brown jellyfish move up and down in the water, probably staying at a particular light intensity. This behaviour probably maintains optimum light for photosynthesis by the zooxanthellae. If the plants produced too much oxygen by photosynthesis, gas bubbles could form, causing the jellyfish to float to the surface and be 'cooked' by the sun. By dropping lower in the water when the sun is bright, the jellyfish can stay in lower light intensities, and maintain the oxygen production at a level that suits the jellyfish and its plant partners.

Do jellyfish 'swarm'?

Jellyfish are moved around by currents in the water. Where wind or tide-driven currents move towards shallow banks and cause water to rise towards the surface, jellyfish may be moved upwards into a zone of high light intensity. A behaviour pattern which has them swimming downwards to lower light intensities in such an 'upwelling' area will cause them to accumulate in that area. Animals being brought into the area by rising currents will join those whose downward movement tends to keep them in the same area. This may well be the mechanism that brings large numbers of the animals together in what appear to be swarms.

This behaviour could have a useful effect at breeding time. High densities of mature animals will increase the success of their breeding because eggs and sperm will be released in much greater concentrations than would occur if the animals were further apart.

A JELLYFISH FISHERY?

Perth people may not hold jellyfish in very high esteem, but that opinion is not shared by people in some other countries. Swan River brown jellyfish could soon be exported to South East Asia where dried jellyfish are a delicacy.

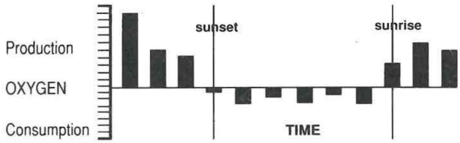
ARE JELLYFISH DANGEROUS?

The mild sting is not dangerous unless it contacts sensitive tissues, especially eyes. Jellyfish should not be thrown at people as there is a risk of eye damage.

FINDING OUT ABOUT THE JELLYFISH

Much of the information in this leaflet is based on research carried out by the undergraduate students in the Bachelor of Applied Science Biology Programme at Curtin University. The student projects have contributed to our understanding of how the brown jellyfish live in the Swan Estuary by finding out about the relationship between the jellyfish and the zooxanthellae (measuring abundance of zooxanthellae compared with free-living microscopic plants) and the relative importance of photosynthesis and respiration by the whole organism at different times of the day. Further projects are planned to find out the nature of the jelly-like substance exuded by the jellyfish, and its importance as food for other organisms.

To measure oxygen use and output, jellyfish were trapped in 7 litre clear cylinders through which estuary water flowed slowly. Any changes in the level of dissolved oxygen were measured. The relative importance of photosynthesis and respiration by the whole organism at different times of day was determined by relating dissolved oxygen levels to the volume of water that flowed through the cylinder and to the size of the jellyfish.



To measure the chlorophyll 'a' content of the jellyfish, an organic solvent was used to extract the pigment from jellyfish tissue. Chlorophyll 'a' indicates the amount of living plant material present. A standard technique allows the concentration of pigment to be measured with a spectrophotometer (as milligrams of chlorophyll 'a').

Quantity of chlorophyll 'a' (micrograms)

Small jellyfish (10-15 ml)	70-120 ug
Medium-size jellyfish (490 ml)	1500 ug
Nutrient-rich estuary water	>20ug/Litre
Nutrient-poor estuary water	< 5 ug/Litre

This leaflet was edited by Karen Majer and designed by LaserDesigns.

This leaflet is one in a series on aspects of Western Australian waterways.

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