

# THE SEAGRASSES OF LAKE ILLAWARRA, NEW SOUTH WALES

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## INTRODUCTION

Ecological studies on seagrasses and seagrass communities in eastern Australia date back only as far as those of Wood (1959a, b). The most detailed studies in New South Wales have been made on the central coast lakes, Lake Macquarie (see King 1986, for references) and Tuggerah Lakes (see King & Holland 1986). Detailed studies in those lakes over five years (King & Hodgson 1986) showed that in terms of the area occupied by seagrasses, species composition of the communities, and the biomass of the eelgrass *Zostera capricorni* Ascherson, there are marked fluctuations which cannot be correlated easily with seasonal or environmental changes. Such variation appears to be inherent in the nature of seagrass communities but has not often been properly documented. In some cases aerial photographs can be used to give an overview of the (recent) history of the distribution of seagrass beds but without concurrent field survey there is no information on species present or biomass.

The biota of Lake Illawarra is of special interest, not only because it is in a region of rapid urbanization with associated recreational use, but also because of proposals to refurbish and upgrade the existing Tallawarra Power Station. Lake Illawarra is already subject to environmental problems, especially eutrophication which has resulted in excessive algal growth (LIMC 1986b), but while this is a major immediate problem the most severe long-term concern is with the infilling of the lake (LIMC 1986a). Lake Illawarra has, as a consequence, been the subject of a range of intensive studies most of which are summarized in the 'Environmental Audit' (SPCC 1986).

The first detailed study of the aquatic flora of Lake Illawarra was that of Harris (1977) who investigated the eelgrass, *Zostera capricorni*, and its environmental requirements. The vegetation map produced for that thesis has been published a number of times (e.g. Harris 1976, Harris *et al.* 1979). Since that time there have been other vegetation maps drawn up for various purposes: by Yassini (1985) in relation to the distribution of algal growth, and by Evans & Gibbs (1981) and West *et al.* (1985) in relation to the inventory of estuaries of NSW undertaken by the Division of Fisheries, Department of Agriculture. The map from West *et al.* (1985) was reproduced in the Lake Illawarra Environmental Audit (SPCC, 1986).

The survey reported here was carried out in March, 1987.

## METHODS

The primary survey methods employed were those used in surveys of Lake Macquarie (King 1986) and Tuggerah Lakes (King & Holland 1986).

Observations on the extent, pattern of cover and species composition of seagrasses were made by use of transects run perpendicular to the shoreline at intervals ranging from 50m where growth was sparse or patchy up to 200 metres in areas where the abundance and growth pattern appeared to be uniform. The transects were extended until the deepest limit of the vegetation, except in small bays and other shallow waters where they were sometimes continued to the opposite shoreline. The methods of observation depended on turbidity and depth and included direct viewing from a boat, raking with a long-handled rake, and wading in very shallow areas. The distance from the shore was measured using a rangefinder (Rangematic MK5: Ranging Inc., (accuracy 99% at 100m, 95% at 500m, 90% at 1000m) for distances over 50m and a Ranging Optimeter 620 for shorter distances).

Two subjective scales were used: a scale of abundance, and a measure of growth or sociability. Each scale has three categories:

- Abundance:
1. Sparse growth (up to 15% cover);
  2. Moderate growth (15-50%);
  3. Abundant growth (>50%).

- Sociability:
- a. individual strands or clumps;
  - b. patches of growth up to 10m;
  - c. beds of relatively even distribution.

Thus the designation of a weed bed as Z1aR2c would indicate a mixed bed of *Zostera* (sparse in individual strands or clumps) with *Ruppia* (moderate growth and relatively evenly distributed). The area covered by weed beds was measured from enlarged copies of the maps using an Apple IIe microcomputer coupled to a graphics tablet.

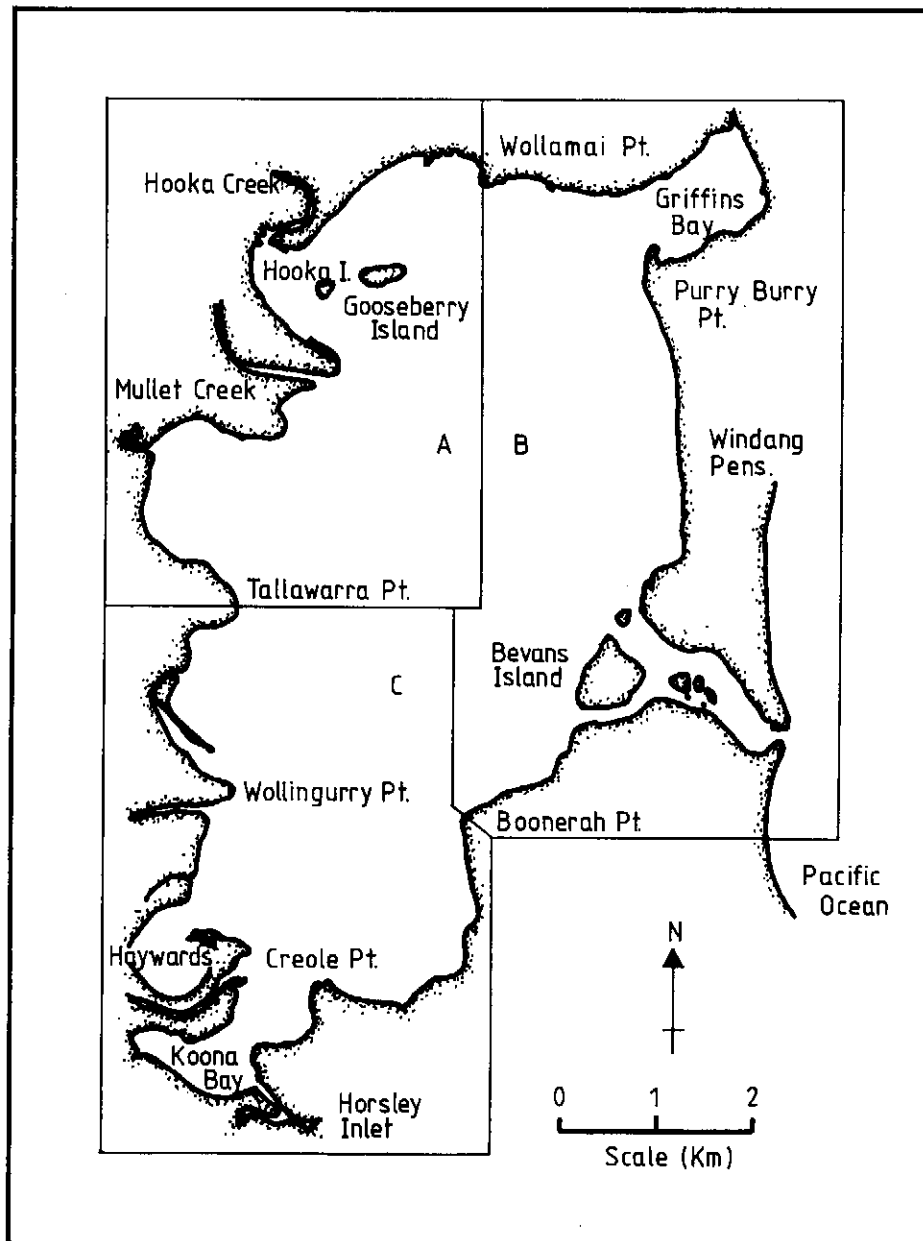


Figure 1. Lake Illawarra locality map, showing the areas referred to in figs. 2-4.

## RESULTS

The results of the survey are given in figures 2-4. Figure 1 is a general locality map. The area occupied by seagrass is given in Table 1, which also includes data from previous published surveys.

**Species present:** the seagrass species recorded in this survey were *Zostera capricorni* Ascherson (eelgrass), *Halophila* sp., and *Ruppia* sp.. Harris (1977) has shown that despite the wide morphological variation shown by *Zostera* in Lake Illawarra it is all properly accommodated within the single species *Zostera capricorni*. *Halophila* in the lake has been referred to as both *H. ovalis* (R. Brown) Hooker and *H. decipiens* Ostenfeld, and the recent recognition of *H. australis*, Daly and Stone in Eastern Australia (Robertson 1984) compounds the issue. All three species are morphologically similar and closely related, and there is little to be gained by applying a specific epithet to *Halophila* in Lake Illawarra until the species has been correctly identified. The *Ruppia* in Lake Illawarra is referred to *R. megacarpa* Mason following Jacobs and Brock (1982).

**Table 1.** Area of seagrass beds (Km<sup>2</sup>) in Lake Illawarra.

|   |                  |                                   |                     |
|---|------------------|-----------------------------------|---------------------|
| Eastern seagrass beds<br>(Boonerah Pt - Wollamai Pt)      | <i>Zostera</i>   | 6.30                              |                     |
|   | <i>Halophila</i> | 0.91                              |                     |
|   | <i>Ruppia</i>    | 3.29                              |                     |
|   | Total            | 8.11                              | (6.99) <sup>1</sup> |
| North-western seagrasses<br>(Wollamai Pt - Tallawarra Pt) | <i>Zostera</i>   | 1.67                              |                     |
|   | <i>Halophila</i> | 0.20                              |                     |
|   | Total            | 1.67                              | (0.89) <sup>1</sup> |
| South-western seagrasses<br>(Tallawarra Pt - Boonerah Pt) | <i>Zostera</i>   | 0.14                              |                     |
|   | <i>Halophila</i> | 0.78                              |                     |
|   | Total            | 0.92                              | (1.61) <sup>1</sup> |
| Total area of Lake Illawarra                              | 36.27            | (West et al. 1985)                |                     |
| Total area of seagrass                                    | 10.70            | (present survey)                  |                     |
|   | 7.96             | (Harris 1976b)                    |                     |
|   | 8.96             | (Evans & Gibbs 1981) <sup>2</sup> |                     |
|   | 5.12             | (West et al. 1985)                |                     |

1. Data read from map in Harris (1976b)
2. Data corrected (P. Gibbs, pers. comm.)

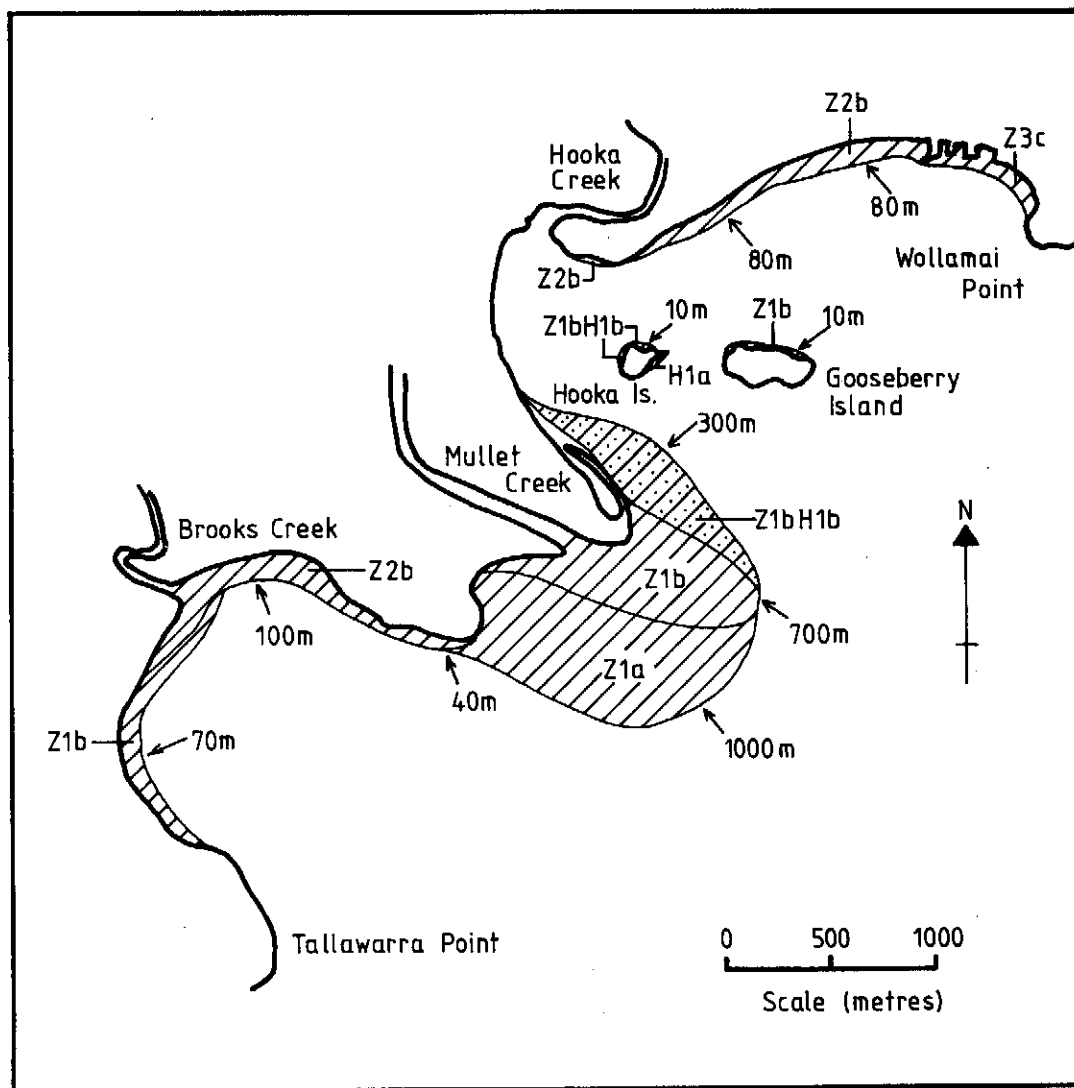


Figure 2. North – western seagrass beds, Wollamai Point to Tallawarra Point.

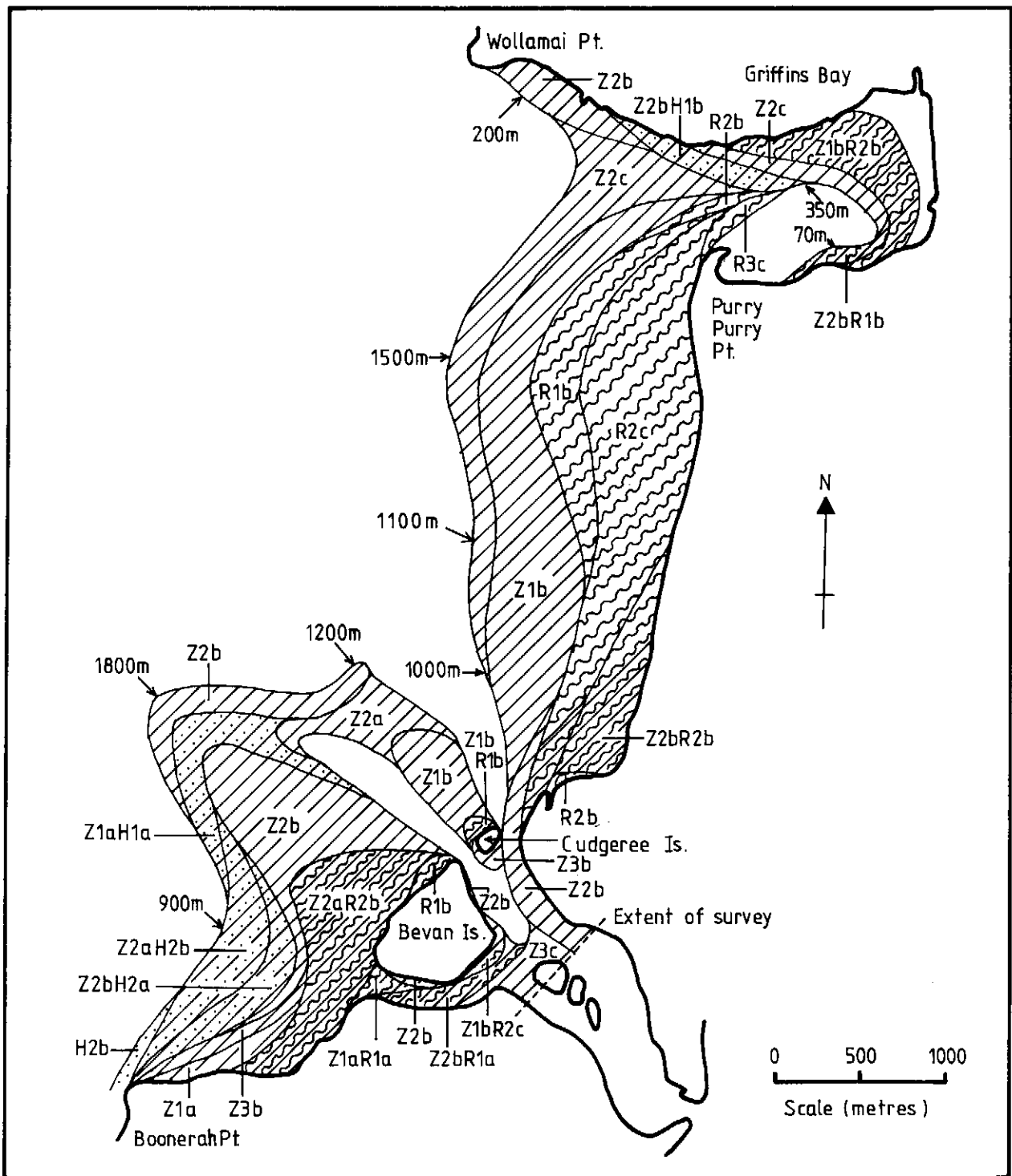


Figure 3. Eastern seagrass beds, Boonerah Point to Wollamai Point.

**DISCUSSION**

The total area of seagrass, measured by a variety of techniques in four surveys and up to 10 years apart, ranges from 5.12 km<sup>2</sup> to 10.70 km<sup>2</sup>. The variation in the figures derived by different workers may be attributed partially to the methods used to obtain them. The figures given for the survey of Harris (1976) were obtained from measurement made on photo-enlarged copies of his published map. The way in which distributions were plotted led to problems in defining boundaries, and this, with the problems of extrapolation from such small-scale maps should not lead one to place too much confidence in the derived data. The low value of West *et al.* (1985) is based on interpretation of aerial photographs (1979 & 1971) coupled with field surveys at a later date (Nov. 1981 & April 1982). Mapping based on aerial photographs does not recognize sparse occurrences. In the present survey 1.7km<sup>2</sup> of seagrass was present in category 1a (sparse and with a low percentage cover) and a good deal of the remainder was category 1b (sparse but in clumps).

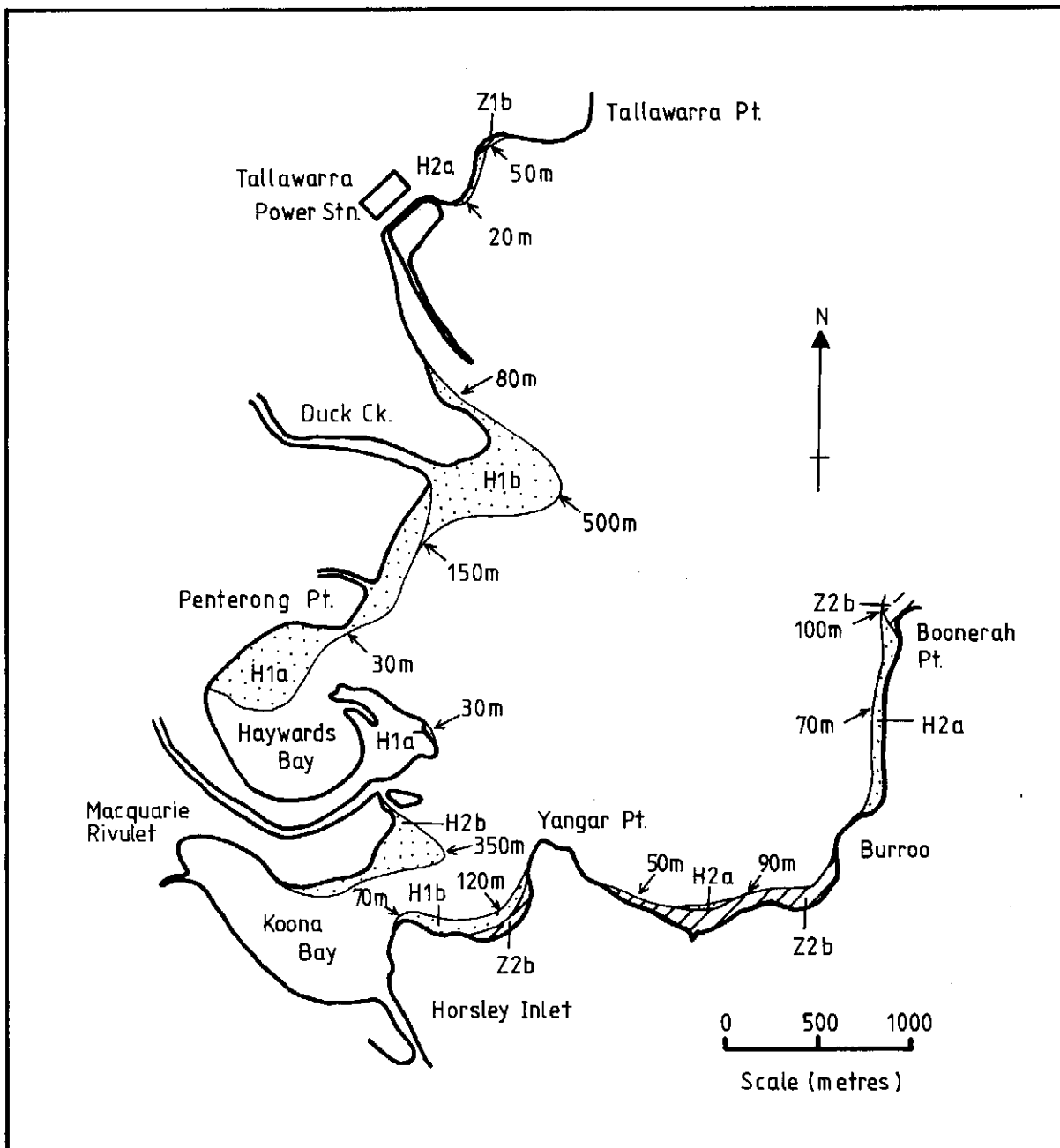


Figure 4. Southwestern seagrass beds, Tallawarra Point to Boonerah Point.

The season in which the survey is undertaken is also critical. Aerial photographs of Lake Illawarra taken in winter (2 June 1987) show an apparently clear demarcation of the eastern weed bed which seems to correspond with the distribution of the *Ruppia* found in the summer survey. Likewise in the area to the south of the mouth of Wollamai Creek the sparse beds of *Zostera* recorded in this survey were not visible. *Halophila* beds mapped here in the southern half of the lake were also not detectable.

As noted in the introduction variation in the area occupied by seagrasses in coastal saline lagoons appears to be a natural aspect of such environments, though world-wide there are few documented cases where the same methodology has been consistently used in surveys at the same season over long time periods. In studies on the Central Coast Lakes, Higginson (1968) reported total percentage seagrass cover for Tuggerah Lakes ranging from 41.9% (May, 1963) to 28.2% (Aug, 1966) but it is possible that some of this difference is due to seasonal change. Studies over a 5 year period (1981-1985) show the area occupied by seagrass in summer in Southern Lake Macquarie to be in the range 4.81-6.65km<sup>2</sup>: In Tuggerah Lakes 13.13-19.11km<sup>2</sup> (King 1986, King & Barclay 1986).

The observations cited above require that great care be taken when interpretation of environmental baseline data is undertaken. Since there can be no control in the accepted sense, impact or change must be inferred from temporal change alone. The problem then is to understand the magnitude of natural fluctuations so that any later comparison is read against this background 'noise'.

In addition to changes in the area of seagrasses in coastal lakes it is not unusual for there to be marked changes in the floristics. This phenomenon has been observed in many lakes but is well documented only for Southern Lake Macquarie and the Tuggerah Lakes (King & Hodgson 1986). On the basis of surveys throughout the 1970's Harris *et al.* (1979) commented on the absence of *Halophila* in the Lake Illawarra. It was not recorded by Evans & Gibbs (1981) either, yet was recorded as widely distributed in the eastern seabeds by West *et al.* (1985), who also noted minor occurrences near both Mullet Creek and Macquarie Rivulet. In the present survey *Halophila* occurred over 1.89km<sup>2</sup> only half of which was in the eastern part of the lake. *Ruppia* seems to be especially prone to variation with great fluctuations recorded, the species apparently disappearing from Tuggerah Lakes (1966) though it had been abundant in previous years (Higginson 1968) and has been so since (King & Barclay 1986). Evans and Gibbs (1981) provide the only other measure of the area occupied by individual species in Lake Illawarra with *Ruppia* occupying 2.16km<sup>2</sup> (*cf.* 3.29 in the present survey) and *Zostera* 7.32km<sup>2</sup> (*cf.* 8.11). In all surveys the greatest area of seagrass is in the so-called 'eastern weed beds' along the Windang Peninsula, and around Bevans Island. In this survey 75% of seagrass coverage occurred on the eastern side of the lake between Boonerah Point and Wollamai Point: a comparable figure based on Harris (1976) is 69%. Any management options for Lake Illawarra involving changes to the sedimentary environment, water quality (including temperature) and movement must take into account the importance of the eastern weed beds.

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