On a broad-leaved form of the seagrass *Posidonia oceanica* (Posidoniaceae) from Algiers (Algeria)

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ABSTRACT


The discovery in the Algiers (Algeria) region of a population of *Posidonia* showing distinct individualisation with reference to the classic description of the species *Posidonia oceanica* (L.) Delile would appear to confirm that this species, endemic to the Mediterranean, is less homogeneous than had previously been thought. The Algerian population at La Marsa differs from the typical taxon (based on observations on the French coasts) in leaf breadth, its greater number of longitudinal vascular bundles, its distinctive karyotype and certain specific anatomical features. It would, however, be premature at this stage to come to any definite conclusions with regard to its systematic position and rank.

INTRODUCTION

*Posidonia oceanica* (Linnaeus) Delile is an endemic species that is widely distributed along the coast of the Mediterranean. The species propagates vegetatively and also by means of seeds. Flowering, however, is relatively rare (Den Hartog, 1970; Giraud, 1976, 1977a, b; Boudouresque and Thelin, 1985; Caye, 1989). In addition, most of the seeds produced abort prematurely (Caye and Meinesz, 1984). This means that throughout most of its range, vegetative reproduction appears to be the principal mode of dissemination. It is possible, therefore, that genetic flow in this species is limited, and that particular clones individualised to a greater or lesser extent, might develop locally. This might well be the case on the Algerian coast in particular, where *P. oceanica*

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meadows are well represented, but where flowering has only rarely been reported. Differences between clones may involve the morphological characteristics of vegetative or reproductive parts, anatomical features (dimensions of the epidermal cells, localisation of fibre cells, number of longitudinal vascular bundles), biological (number of leaves produced per year) or phenological characteristics.

As regards our present state of knowledge of *P. oceanica*, the comparative studies that are available deal with the phenology and biometry of the leaves of populations in the northwestern Mediterranean basin (Giraud, 1977a; Giraud et al., 1977; Ott, 1980; Panayotidis and Giraud, 1981; Wittmann et al., 1981; Bay, 1984; Pirč, 1984; Pessini et al., 1984; Romero-Martinengo, 1985; Caltagirone, 1986; Panayotidis, 1986; Pergent and Pergent-Martini, 1988; Rico and Pergent, 1990). Data for the North African coasts are fragmentary or not very recent (Molinier and Picard, 1953; Farghaly and Dcnizot, 1984; Pergent and Pergent-Martini, 1988; Semrourd et al., 1990).

With regard to anatomical features of *Posidonia oceanica* (rhizomes, leaf sheaths and blades), work that is fairly detailed but old includes that of Grenier (1860), Sauvageau (1890a, b, 1891), Monoyer (1928) and Pottier (1934). Recent, but unfortunately incomplete, studies are those of Albergoni et al. (1978), Mariani et al. (1980), Colombo et al. (1983) and Crouzet (1984). Detailed anatomical examinations of Australian species have resulted in a considerable body of information (Cambridge, 1975; Kuo, 1978; Kuo and Cambridge, 1978; Cambridge and Kuo, 1979; Cambridge and Kuo, 1982; Kuo and Cambridge, 1984; Kuo and McComb, 1989). As a result of investigations of *P. oceanica* meadows along the Algerian coast, we report a population in the vicinity of Algiers characterised by leaves that are broader than those of *P. oceanica* found along the French coasts.

The objectives of our study of this *P. oceanica* population were to determine: whether the biometric characteristics (especially the breadth of the leaves) remain distinctive and stable throughout the annual cycle in the stations where this population has developed, whether the plants from this population have a distinctive karyotype, and whether leaf sheaths and leaf blades have a distinctive anatomical structure (number of longitudinal vascular bundles, epidermal cells, fibre cells).

MATERIALS AND METHODS

The plants studied were taken from natural populations situated at La Marsa, at the eastern end of the Bay of Algiers near Cap Matifou (Algeria), in an area with strong water movement, at Port-Cros (Var, France), and at Sausset (Bouches-du-Rhône, France) (Fig. 1). Samplings were carried out by SCUBA diving at depths of between 8 and 11 m.
Morphology

At La Marsa, the samples for biometrical and phenological analysis consisted of five replicates of 15 orthotropic rhizomes, each with living leaf shoots, situated 1 m apart. Seventy-five shoots per station and per depth were taken at 3-month intervals between October 1988 and July 1989. The examinations were carried out according to the procedure described by Giraud (1977a).

The parameters examined were: the breadth and length of the leaves; the number of leaves per shoot; the number of leaves produced per year. However, as the breadth of the adult leaves at the end of the growth phase appeared to be the sole distinctive morphological criterion with reference to other Mediterranean populations, only the results for this parameter are presented here. Statistical analysis of the data was carried out using the Statgraphics program: variance analyses, comparison of means and Kruskal and Wallis, Tukey, Scheffé and Student–Newman–Keuls tests were carried out (Dagnelay, 1973–75; Underwood, 1981; Zar, 1984).

Karyology

Samples for karyological analysis were taken in April 1989 at La Marsa, in November 1982 at Port-Cros and in October 1982 at Sausset. Fixation was carried out on leaf meristems in 100% ethanol–glacial acetic acid (4:1). Fixed specimens, stored in a deep-freezer at −18°C, were stained with acetocarmine (boiling for 3 min), then mounted between slides and squashed. The slides were observed with a Wild M18 microscope, and camera lucida drawings were made.

Idiograms were established from the best somatic metaphases (several drawings for each meristem and two or three meristems per station) in order
to determine more precisely the mean karyotype for various populations. The conventions adopted for the schematisation of the idiograms were: for each element to represent one pair of chromosomes and classification of chromosomes in descending order of size with alignment of the centromeres, with the shortest arm of the chromosome at the top of the drawing. The position of the centromeres is reported according to the $R$ ratio of the arms of each chromosome (Levan et al., 1964):

$$
\begin{align*}
R &= 1-1.05 & Me & \text{median} \\
R &= 1.05-1.7 & m & \text{median region} \\
R &= 1.7-3 & sm & \text{submedian} \\
R &= 3-7 & st & \text{subterminal} \\
R &= >7 & t & \text{terminal region}
\end{align*}
$$

Intermediary positions are indicated by a dash (e.g. m–sm); variations or rare examples are given in parentheses.

**Anatomy and histology**

The anatomical examination was carried out on transverse sections of adult sheaths and leaf blades taken 13–15 mm from the base for the Port-Cros samples, and 17–20 mm from the base for the La Marsa samples, to allow for the difference in size of the sheaths and leaves between the two sites. These were mounted with a hydromount, either without staining, or after treatment with Congo red and then iodide green (Seguy, 1949). At La Marsa and Port-Cros, 25 shoots taken in April were examined: on each shoot two adult leaves and two thick sheaths corresponding to the maximum in the lepidochronological cycle (demonstrated by Pergent et al., 1989) were sampled.

**RESULTS AND DISCUSSION**

**Morphology**

The breadth of *Posidonia oceanica* leaves generally increases, according to their position, with their rank within a given shoot: those of the highest rank, i.e. the oldest which are furthest from the centre, are the broadest, regardless of the period of the year. The breadth of the leaves on rhizomes taken in the La Marsa station generally ranges from 9 to 14 mm, with a few leaves of as much as 15 mm. The breadth of the leaves in French populations generally ranges between 8 and 12 mm. The frequency distributions obtained show that there is a slight variation in mean values according to the season (Fig. 2, Table 1). Maximum values are found in April (significant at the 0.25 thresh-
Fig. 2. Frequency (in percent) of the breadth of *P. oceanica* adult leaves for La Marsa (depth 8–10 m) and Port-Cros (depth 10–11 m).

### TABLE 1

Seasonal variation in the breadth (mm) of adult leaves of *P. oceanica* at La Marsa and Port-Cros (data in Pergent, 1987)

<table>
<thead>
<tr>
<th>Station</th>
<th>October</th>
<th>January</th>
<th>April</th>
<th>July</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Marsa</td>
<td>$x$</td>
<td>11.39</td>
<td>11.74</td>
<td>11.49</td>
</tr>
<tr>
<td></td>
<td>$\sigma$</td>
<td>0.97</td>
<td>0.94</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>$\nu$</td>
<td>0.94</td>
<td>0.87</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>$n$</td>
<td>261</td>
<td>193</td>
<td>232</td>
</tr>
<tr>
<td>Port-Cros</td>
<td>$x$</td>
<td>10.63</td>
<td>10.32</td>
<td>10.29</td>
</tr>
<tr>
<td></td>
<td>$\sigma$</td>
<td>0.80</td>
<td>0.55</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>$\nu$</td>
<td>0.64</td>
<td>0.30</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>$n$</td>
<td>91</td>
<td>58</td>
<td>61</td>
</tr>
</tbody>
</table>

$x$, mean; $\sigma$, standard deviation; $\nu$, variance; $n$, number of adult leaves.

...old). A high percentage of adult leaves (52%; $n = 1322$) show a breadth greater than or equal to 12 mm.

The mean breadth of *P. oceanica* leaves at La Marsa is significantly different at the 0.05 threshold from that of leaves from the Port-Cros station (data in Pergent, 1987) (Figs. 2 and 3). Comparison of the histograms of frequency for breadth of adult leaves shows that the modes are quite distinct. Regardless of the season, the mode is within the 10 mm class at Port-Cros, and the 11 or 12 mm classes at La Marsa (Fig. 2). Variations in the mean breadth of *P.*
oceanica leaves have been reported by several authors (Table 2). Giorgi and Thelin (1983) and Pergent (1987) note that the breadth of adult blades at the end of the growth phase varies in some areas with depth, although leaves as broad as those observed at La Marsa have never been reported elsewhere.

The biometric and phenological characteristics of P. oceanica (length and breadth of leaves, rhythm of development of young leaves at the apex, etc.) vary with season and depth, and also from one station to another (Port-Cros and Banuys in France, Urla in Turkey) at the same depth and at the same time of year (Pergent, 1987). These variations can be explained, according to Pergent (1987), by differences in light conditions. Caye (1989), however, thinks that these variations are probably of genetic origin. The maximum breadth of adult leaves grown in the laboratory does indeed differ from one individual to another, but shows little or no change during the course of the experiment for any given plant (Caye, 1989).

Posidonia oceanica rhizomes taken from La Marsa were transplanted at Port-Cros at about 20 m depth in June 1990, in the immediate proximity of indigenous populations. The following year (and consequently after complete renewal of the leaves, which have a life cycle of less than 1 year; Ott, 1980), the transplanted individuals had developed leaves as broad as those in their original station (A. Meinesz, personal communication, 1991).
TABLE 2

Bibliographical data on the mean breadth of *Posidonia oceanica* leaves (adult and intermediate leaves together)

<table>
<thead>
<tr>
<th>Country</th>
<th>Author</th>
<th>Site</th>
<th>Mean breadth (mm)</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Giraud, 1977</td>
<td>Marseille</td>
<td>8 à 12</td>
<td>Variable</td>
</tr>
<tr>
<td></td>
<td>Giorgi and Thelin, 1983</td>
<td>Port-Cros</td>
<td>10.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Pergent, 1987</td>
<td>Port-Cros</td>
<td>9.8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.3</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.3</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Banuys</td>
<td>8.3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.8</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.0</td>
<td>19</td>
</tr>
<tr>
<td>Italy</td>
<td>Caltagirone, 1986</td>
<td></td>
<td>9.6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.0</td>
<td>10</td>
</tr>
<tr>
<td>Sicily</td>
<td>Pessani et al., 1984</td>
<td>Ischia Aeo</td>
<td>8.0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>l Islands</td>
<td>8.9</td>
<td>9</td>
</tr>
<tr>
<td>Sardinia</td>
<td>Rico and Pergent, 1990</td>
<td>Porto Conte</td>
<td>8.6</td>
<td>4–6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.9</td>
<td>8–12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.6</td>
<td>15–23</td>
</tr>
<tr>
<td>Turkey</td>
<td>Pergent, 1987</td>
<td>Urla</td>
<td>9.7</td>
<td>2</td>
</tr>
<tr>
<td>Algeria</td>
<td>Semroud et al., 1990</td>
<td>La Marsa</td>
<td>10.8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamentfoust</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.3</td>
<td>8</td>
</tr>
</tbody>
</table>

In Australian species of the genus *Posidonia*, the breadth of the leaves varies from 1 to 2 mm in *Posidonia denhartogii* Kuo & Cambridge, to as much as 15–20 mm in *Posidonia australis* Hook. f. (Kuo, 1978; Kuo and Cambridge, 1984).

The general shape of the sheaths (Figs. 4A and 4B) is similar, with two fairly straight flaps or stipules, tightly folded over the next internal leaf. However, the breadth of these expansions differs: it represents 60–80% of the overall breadth of the sheath in the La Marsa *P. oceanica*, as against 50–60% in the Port-Cros population.

**Karyology**

The La Marsa, Port-Cros and Sausset *P. oceanica* populations show a constant diploid chromosome number of $2n=2X=20$, which confirms the findings of Contandriopoulos and Verlaque (1984) and Den Hartog et al. (1987). The same chromosome number is found in all known Australian species
Fig. 4. Transverse sections at similar level of *Posidonia oceanica* sheaths, at La Marsa (A) and Port-Cros (B). ab. ep., abaxial epidermis; ad. ep., adaxial epidermis; ab. f. bu., abaxial fibre bundle; ad. f., adaxial fibre; cent. v. bu., central vascular bundle; lat. v. bu., lateral vascular bundle; mes., mesophyll.
(Keighery and Coates, 1981; Kuo et al., 1990); this proves the karyological stability of the genus.

Detailed comparison of our extensive set of drawings and the corresponding idiograms reveals, apart from the very high degree of heterogeneity in the size of the chromosomes, the presence of multiple secondary constrictions and several, sometimes barely visible and fluctuating, satellites (Figs. 5 and 6). In addition, there are marked variations in the dimensions of the chromosomes, and sometimes in the position of the centromeres as well, within a given population. For these reasons, we have chosen to present a table with a summary of our findings (Table 3), giving the extreme sizes (rather than the means) for each of the ten pairs of highly characteristic chromosomes.

Comparison of the somatic metaphases (Figs. 5A and 5C) and of the idiograms (Fig. 6) shows that the karyograms have a generally rather similar

![Image of chromosomes](image_url)

Fig. 5. Somatic metaphases (A, C) and anaphases (B, D) in *P. oceanica* at La Marsa (A and B) and Port-Cros (C and D).
Fig. 6. *Posidonia oceanica* idiograms: A, la Marsa; B, Port-Cros.

### TABLE 3

Comparison of the ten pairs of *P. oceanica* chromosomes from the three study stations

<table>
<thead>
<tr>
<th>Pair</th>
<th>La Marsa</th>
<th>Port-Cros</th>
<th>Sausset</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L (μm)</td>
<td>Centro/Sat</td>
<td>L (μm)</td>
</tr>
<tr>
<td>1</td>
<td>6.5–8.0</td>
<td>m</td>
<td>5.4–6.0</td>
</tr>
<tr>
<td>2</td>
<td>6.0–7.0</td>
<td>m*</td>
<td>4.9–5.6</td>
</tr>
<tr>
<td>3</td>
<td>5.4–6.7</td>
<td>sm</td>
<td>4.6–5.4</td>
</tr>
<tr>
<td></td>
<td>3.8–4.5</td>
<td>m-sm*</td>
<td>3.8–4.5</td>
</tr>
<tr>
<td>4</td>
<td>3.8–4.5</td>
<td>m*</td>
<td>2.8–3.2</td>
</tr>
<tr>
<td>5</td>
<td>3.2–3.6</td>
<td>m</td>
<td>2.4–2.7</td>
</tr>
<tr>
<td>6</td>
<td>2.7–3.3</td>
<td>st/Sat</td>
<td>2.4–2.9</td>
</tr>
<tr>
<td>7</td>
<td>2.5–3.2</td>
<td>m*</td>
<td>2.0–2.4</td>
</tr>
<tr>
<td>8</td>
<td>1.5–2.1</td>
<td>st/(Sat*)</td>
<td>1.8–1.9</td>
</tr>
<tr>
<td>9</td>
<td>1.8–2.2</td>
<td>(t)st</td>
<td>1.6–1.9</td>
</tr>
</tbody>
</table>

*L*, extreme lengths; Centro/Sat, centromeres and satellites; ( ), rare or fluctuating examples; *, distinctive character of populations. The horizontal line divides the group of large chromosomes from the smallest ones.

and characteristic appearance, with a very high degree of size disparity in chromosomes with centromeres occupying, for the most part, similar positions. However, detailed analysis of the two karyotypes reveals a number of significant and quite distinctive differences. The La Marsa population differs from those of Port-Cros and Sausset in the following respects:

(i) fairly unstable satellites on the seventh pair (st) and on the sixth (m) or the ninth (m) pair, whereas they are always on the seventh and the eighth pairs in the French populations;

(ii) three centromeres situated in the median region (m) on pairs 2, 4 and 8 (respectively sm, m-sm and sm in France), the remaining centromeres being similar in the two groups;
(iii) the overall higher size range of the chromosomes: 1.8–8 μm at La Marsa, as against 1.6–6.3 μm for the French populations.

This last feature is in fact the one that most clearly distinguishes the Algerian population from those of the French coast. This non-proportional difference in size applies primarily, and significantly, to the three largest pairs. This results in an obvious dimensional discontinuity, which produces a different distribution of the chromosomes. The Algerian P. oceanica is thus clearly distinguished from the others by the occurrence of a homogeneous group of three large pairs (often metacentric: 2 m + 1 sm) of 5.4–8 μm (difference of 1.5–2 μm compared with the fourth pair), whereas those from the French coast have a group of four large pairs (more asymmetrical: sm) of 3.8–6.3 μm (difference of 1–1.5 μm compared with the fifth pair). This difference in size, already apparent in the metaphases (Figs. 5A and 5C), becomes clearly visible during observation of the anaphases (Figs. 5B and 5D), when the longest pairs (three or four, depending on the population) are arranged on the edges of the slide around the other chromosomes, that are much smaller and shorter at this stage.

The idiograms we obtained for the populations from the French coast cannot be superimposed on those proposed by Contandriopoulos and Verlaque (1984) on specimens which were also taken from Port-Cros and Sausset. This disparity results partly from the use of a different microscope and projection system and from the considerable difficulties of observation (rare divisions), but above all from the strong morphological variations in the chromosomes during mitosis and according to the condition of the fixations. Usually, during metaphase the chromosomes appear packed and much shorter, with the centromeres barely visible, which makes them easier to count, but results in very approximate idiograms. From our whole set of samples, we have accordingly selected the best fixations, and among these, the metaphase slides that present an analogous state and involve the least difficulty of interpretation; i.e. chromosomes concentrated in a ‘normal’ way with quite distinct centromeres.

This analysis thus reveals two quite distinct karyotypes for Posidonia oceanica in the western Mediterranean, and suggests the occurrence of a not insignificant chromosome evolution in this ‘species’ throughout its range. This marked (and hitherto unexpected) karyological differentiation might be compared with the very high degree of morphological and anatomical speciation in the genus Posidonia in Australia, where eight species have now been identified. Unfortunately, it is impossible at this stage to establish a detailed comparison with the Australian species (all 2n=2X=20). The “small chromosomes with little observable karyotypic detail” reported for five Australian taxa (Keighery and Coates, 1981) no doubt result from the use of certain pretreatments (colchicine and cold) which induce shortening of the chromatin. According to the recent study of Kuo et al. (1990), “all 8 Australian
*Posidonia* spp. appear to possess 5 pairs of larger chromosomes and 5 pairs of smaller chromosomes, the latter being less than half the bulk of the former... Speciation in *Posidonia* has not involved chromosome number change nor has it involved coarse changes in chromosome morphology”. Therefore, the genus *Posidonia* includes two evolutionary groups: (i) the Australian taxa with a similar bimodal karyotype and a great morphological and biogeographical differentiation; (ii) the Mediterranean endemic group (*P. oceanica* sensu lato) morphologically rather homogeneous but karyologically more differentiated.

Anatomy and histology

Comparison of samples from La Marsa and Port-Cros reveals certain similarities but also marked differences in the anatomical and histological characteristics of the leaf sheaths and blades.

With regard to the sheaths, the following observations were made.

(i) In both populations, lignified fibre cells are found immediately below the epidermal cells (adaxial side: in one- to three-cell layers) or the hypodermal cells (abaxial side: in bundles). It should be pointed out, however, that the fibre cells in samples from the Algerian coast (Fig. 7C) are in almost all cases of small size with thinner walls than those in the French populations (Fig. 7D).

(ii) The mesophyll tissue below the hypodermis is virtually identical in the two sets of samples, with fairly large parenchyma tissue enclosing small air lacunae. It should be noted, however, that there are more tannin cells in the Algerian specimens, and an adaxial hypodermis with longer cells in proximity to the flaps.

(iii) The height of the abaxial and adaxial epidermal cells (Figs. 7C and 7D) differs quite distinctly between the two populations (Table 4); this difference is particularly marked in the thickest sheaths.

(iv) The number of longitudinal vascular bundles ranges from 19 to 21 \((x=20.1; n=50)\) at La Marsa, whereas it is between 15 and 18 (19 in rare cases) \((x=17.1; n=50)\) at Port-Cros. The values differ significantly at the 0.05 threshold.

Examination of the leaf blades in the two populations also revealed both general similarities and certain distinctive features.

(i) In surface view, the abaxial and adaxial subrectangular epidermal cells appear similar in the two populations of *P. oceanica*, with dimensions of 22–30 \(\mu\)m \(\times\) 7–10 \(\mu\)m.

(ii) In transverse sections, the number of layers of parenchyma cells making up the mesophyll tissue ranges from five to six at La Marsa, and from three to four at Port-Cros.

Recent data (Kuo, 1978; Cambridge and Kuo, 1979; Cambridge, 1984; Kuo
Fig. 7. Diagram (A, B) of part of transverse sections of *P. oceanica* sheaths, and histological drawing of tissues (C, D) (La Marsa, A and C; Port-Cros, B and D). ab. ep., abaxial epidermis; ad. ep., adaxial epidermis; ab. f. bu., abaxial fibre bundle; ad. f., adaxial fibre; air l., air lacunae; cut., cuticle; lat. v. bu., lateral vascular bundle; mes., mesophyll; tan. c., tannin cell.

and Cambridge, 1984) have made it possible to distinguish between the different species of *Posidonia* on the basis of breadth, thickness, epidermal cells, lignified fibre cells and number of longitudinal vascular bundles of the leaves.
and sheaths. For all species of *Posidonia* identified in Australia, the number of longitudinal vascular bundles in the leaves ranges from three to five (*Posidonia ostenfeldii* den Hartog) to 14–20 (*P. australis* Hook. f.). Lignified fibre cells either occur immediately below the epidermis or the hypodermis (species of the *P. australis* group: *P. australis*, *Posidonia angustifolia* Cambridge & Kuo, *Posidonia sinuosa* Cambridge & Kuo), or in the mesophyll tissue (species of the *Posidonia ostenfeldii* group: *P. ostenfeldii* den Hartog, *Posidonia robertsoniae* Kuo & Cambridge, *P. denhartogii* Kuo & Cambridge, *Posidonia coriacea* Cambridge & Kuo, *Posidonia kirkmanii* Kuo & Cambridge). The number of longitudinal vascular bundles in the sheaths ranges from 9–15 (*P. coriacea*) to 13–21 (*P. australis*).

According to the literature, in *P. oceanica* the number of longitudinal vascular bundles in the leaves ranges from 11 to 15, and the number of longitudinal vascular bundles in the sheaths from 13 to 17. Lignified fibre cells are only found immediately below the epidermal cells or hypodermal cells, never in the mesophyll tissue; their bundles are always on the abaxial side (Sauvageau, 1890a; Den Hartog, 1970; Albergoni et al., 1978).

It would appear, then, that the leaf sheaths of the La Marsa *P. oceanica* population differ from the classic *P. oceanica* data (confirmed by examination of the Port-Cros samples) in a number of features, notably in transverse section, in the shape and dimensions (breadth and height) of the epidermal cells, in the shape and thickness of the wall of lignified fibre cells and in the number of longitudinal vascular bundles (19–21 instead of 13–17). A similar numerical variation is found in the leaf blades: 15–17 vascular bundles for La Marsa, and 14–15 for Port-Cros.

If the Australian species are compared with the Algerian samples, the only example which might be considered similar is *P. australis* with regard to the breadth of the leaves, the localisation of lignified fibre cells and the number of longitudinal vascular bundles. Although 21 longitudinal vascular bundles in the sheath is unusual in *P. australis*, it is very common in *P. oceanica* from La Marsa. One notable difference does appear with regard to the epidermal
cells in surface view: the length/breadth ratio is approximately 1–1.5 in \textit{P. australis}, and 1–3 (5) in \textit{P. oceanica} from La Marsa.

\section*{CONCLUSIONS}

It was previously thought that a single species of the genus \textit{Posidonia}, \textit{P. australis}, occurred in Australia. However, since 1970 several distinct species that had hitherto been confused with each other have been identified, largely on the basis of their morphological and anatomical characteristics. In the Mediterranean, however, the homogeneity of the single known endemic species, \textit{P. oceanica}, has so far never been called into question. Only Contandriopoulos and Verlaque (1984) briefly pointed out the occurrence of various morphological differences in certain \textit{P. oceanica} populations in the eastern Mediterranean, and suggested that a more detailed karyological investigation was necessary.

The rarity of sexual reproduction in \textit{P. oceanica} (at least in the northwestern basin), and the isolation of certain populations, owing to the complex and compartmentalised geography of the Mediterranean, suggests that distinct taxa may have differentiated locally in several basins. Given the age of the genus (Stockmans, 1932) and the particularly disturbed geological history of the region, speciation and differentiation might well have occurred, and may still be in progress today as a result of genetic drift.

The discovery of a \textit{Posidonia} population in the Algiers region that is distinctively aberrant with reference to the classic description of the species \textit{P. oceanica}, confirms that the genus \textit{Posidonia} in the Mediterranean is less homogeneous than had previously been thought. It may be that broad-leaved \textit{Posidonia} occur elsewhere in the Mediterranean. Pignatti (1982) does indeed mention, in his study of the flora of Italy, the occurrence of leaves with a breadth of as much as 15 mm, which means that he may have had access to samples comparable with those taken at La Marsa.

It would seem premature at this stage to draw any definite conclusions as to the taxonomic position of the La Marsa population. Any future flowering of this population might shed new light on the question. In the meantime, more exhaustive morphological, anatomical, histological, karyological and biochemical investigations on \textit{Posidonia} in the whole Mediterranean basin are required, in order to settle the question of the taxonomy of the genus in the area.

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