Dragon Search: Public Report

Summary of South Australian Sighting Data, to May 2005

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The following organisations and programs have supported and/or promoted Dragon Search in SA:

Part 1 of the report below discusses the sightings recorded by Dragon Search divers and beachcombers between January 1990 and May 2005. Additional historical records and undated records from Dragon Search reporters and the South Australian Museum are presented in Part 2 of this report. In most cases, specific locations at which live seadragons have been sighted are not discussed in this report, to preserve a confidentiality agreement made by Dragon Search with the divers who have provided information for the program. Site-specific details have been listed only for those localities that are well known and publicly promoted for viewing seadragons. An internal version of this report, which contains site-specific information, is available upon request to Dragon Search.

Part 1

Part 2

1. State-Wide Distribution of Sightings (January 1990 - May 2005)

Both Species: To 5th May 2005, 827 sightings have been recorded in South Australian waters for the Dragon Search Program, including 79 records in which leafies and weedies were recorded together, and 4 sightings in which seadragons were not seen. The number of records also includes, in some cases, repeat sightings over time of the same animals. To date, around 2390 seadragons have been reported in the main database (January 1990 – 5th May 2005), including a number of cases in which the same animals were recorded. A number of significant historical sightings have also been provided to Dragon Search, and are discussed in **Part 2** of this report. The number of sightings per year recorded between 1990 and 2004 are listed below, excluding the 4 records in which seadragons were not seen. To May 4th 2005, there have been 13 sightings reported so far in the 2005 year.

Year	***Total No. Sightings***
1990	9
1991	24
1992	16
1993	8
1994	14
1995	46
1996	54
1997	93
1998	116
1999	131
2000	84
2001	77
2002	86
2003	22
2004	23

The distribution of sightings per year reflects the increasing promotion of Dragon Search during the late 1990s (following the development of the program in 1995-96), and the increasing awareness of the program by divers and beachcombers over the latter part of that decade.

Weedies: To date, there have been 394 sightings of weedies (representing around 1286 animals), including repeat sightings of the same seadragons in some areas.

Leafies: To date, 508 sightings of leafies have been recorded, representing 1104 animals, including repeat sightings.

Both Species Sighted: To date, 79 records have been reported in which both leafies and weedies were seen together, included in the above statistics.

It is noted that the database contains one sighting of a "mass" of live leafies observed by a diver, and a number of reports of masses of dead leafies and weedies on beaches (predominately reported during the two "pilchard kill" events in SA waters during the late 1990s), which are discussed in a later section of this report. Such records can produce bias in calculations of the number of seadragons recorded according to variables such as month, location, depth, habitat type, sighting mode etc.

2. Bioregional Distribution of Sightings

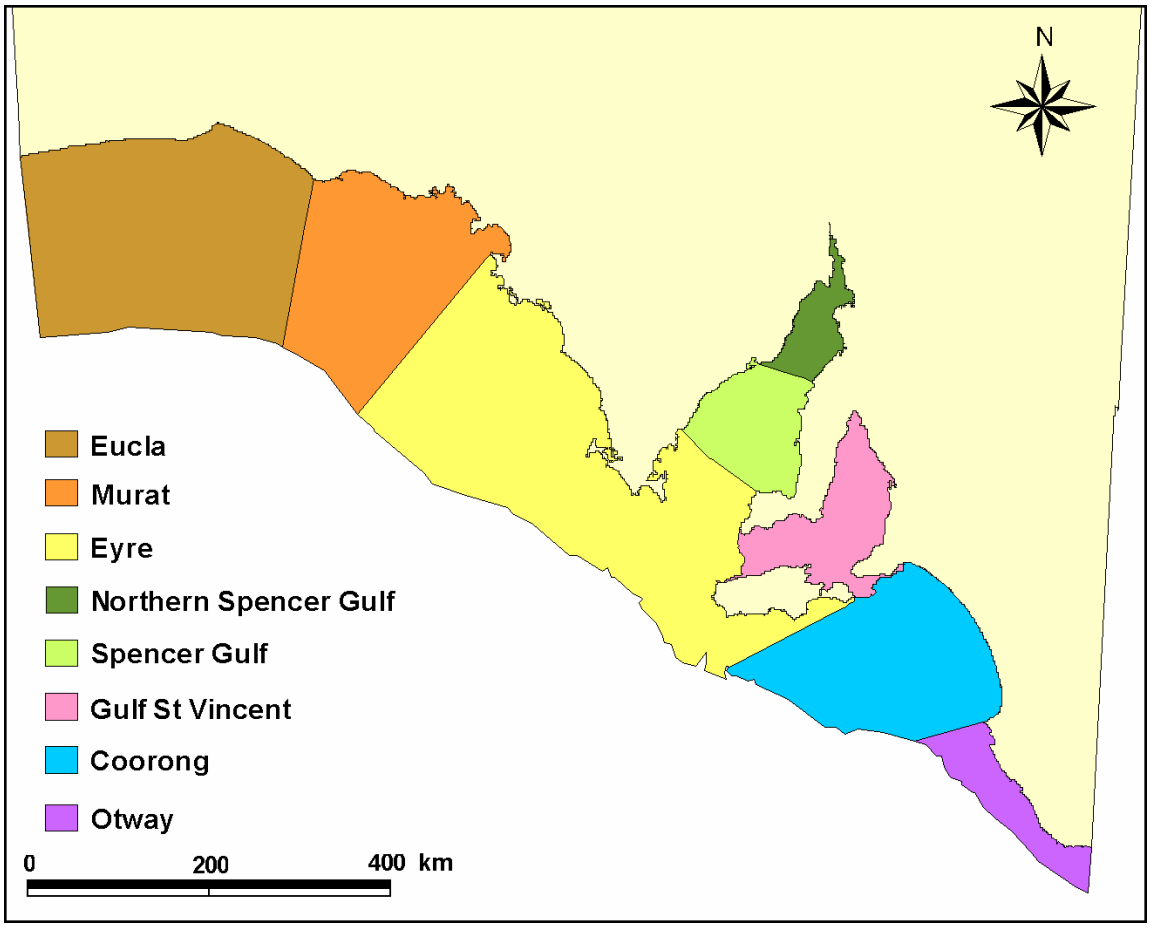
Both Species: The locations of South Australia's 8 marine Bioregions, as specified by the Commonwealth (IMCRA Technical Group, 1998) are shown in **Map 1**.

- About 83% of sightings, and 68% of the total number of seadragons sighted, have come from locations in the Gulf St Vincent (SVG) Bioregion;
- 9% of sightings (and nearly 24% of seadragons, including mass sightings) have been recorded from the Eyre Bioregion (EYR);
- 2% of sightings (1% of seadragons sighted) came from the Coorong (COR) Bioregion;
- 2% of sightings (also 2% of seadragons sighted) came from the Otway (OTW) Bioregion;
- nearly 2% sightings (0.7% of seadragons sighted) came from the Spencer Gulf (SGF) Bioregion;
- 1% of sightings (3.5% of seadragons sighted, including the numbers from mass sightings) came from the Murat (MUR) Bioregion; and
- There was 1 record (representing 7 weedy seadragons) from the Eucla Bioregion (EUC), on the far west coast of South Australia.

The figures cited above are likely to reflect greater knowledge of the Dragon Search program amongst divers (and a relatively greater number of divers) in the more populated and accessible areas of South Australia, including tyre reefs and wrecks around the metro area; popular dive spots along the southern Fleurieu (e.g. Port Noarlunga; and particularly Rapid Bay and Second Valley); Victor Harbor (e.g. the Bluff, and various reefs and islands in Encounter Bay); jetties along western Gulf St Vincent / eastern Yorke Peninsula; as well as the contribution of a number of records (including repeat sightings) from sites on northern and north-eastern Kangaroo Island where seadragons are regularly observed during dive tours. There are also several beachcombers in the metropolitan and southern Fleurieu regions who consistently provide records, as well as a larger number of beachcombers in that region, compared with more remote locations. This accounts for the relatively high collective number of beachcombing records from several SVG Bioregion beaches (such as Henley Beach, Sellicks, and beaches in Encounter Bay), discussed later in this report.

Weedies: Of the 394 sightings in which weedies have been reported, 77% of the records have come from locations in the Gulf St Vincent (SVG) Bioregion (see above); around 11% have come from the Eyre Bioregion; 4% from the Otway Bioregion; around 3% from the Coorong Bioregion; 2% from the Spencer Gulf Bioregion, and almost 2% from the Murat Bioregion.

Leafies: Around 89% of the 508 leafy seadragon sightings recorded to date have come from the SVG Bioregion; 7.5% from the EYR Bioregion; around 1% each from the COR and SGF Bioregions, and less than 1% from the MUR and OTW Bioregions (4 records and 2 records, respectively).



Map 1: South Australian Marine Bioregions (IMCRA Technical Group, 1998).

Weedies and Leafies Sighted Together: Around 91% of the 79 sightings of both species together have come from locations in the SVG Bioregion, mostly from Rapid Bay (60 records), with 3 records from Seacliff; 2 records each from Edithburgh, Second Valley area, and Encounter Bay; and one each from Sellicks in the southern metro area; a bay off Innes National Park on southern Yorke Peninsula, and a dive site off northern Kangaroo Island. For the Eyre Bioregion, 3 reports of both species sighted together came from Anxious Bay, and one report each from two bays on southern Kangaroo Island. One record of both species came from the Murat Bioregion (Corvisart Bay, also known as "Back Beach") and one from the Otway Bioregion (from a nearshore reef in the lower South-East).

Biounit Distribution of Sightings: **Figure 1a** below shows the distribution within South Australian marine "biounits" (Edyvane, 1999) of seadragon sightings that have been recorded by Dragon Search between January 1990 and June 2004 (including repeat sightings at the same location). Biounits are coastal marine classification and planning units, devised by Ortiz (1992) for bioregional classification in NSW, and later applied to S.A. coastal marine areas by Edyvane (1999). Biounits in S.A. have been classified using coastal marine geomorphological and geological data, physiographic features, small spatial scale oceanographic features, and the distribution of some of the major benthic habitat types. Nominal biounit boundaries were set at 30m for the gulfs biounits, and 50m for oceanic biounits (see Edyvane, 1999, for S.A. Biounit descriptions). The distribution in **Figure 1a** includes repeat sightings at the same locations.

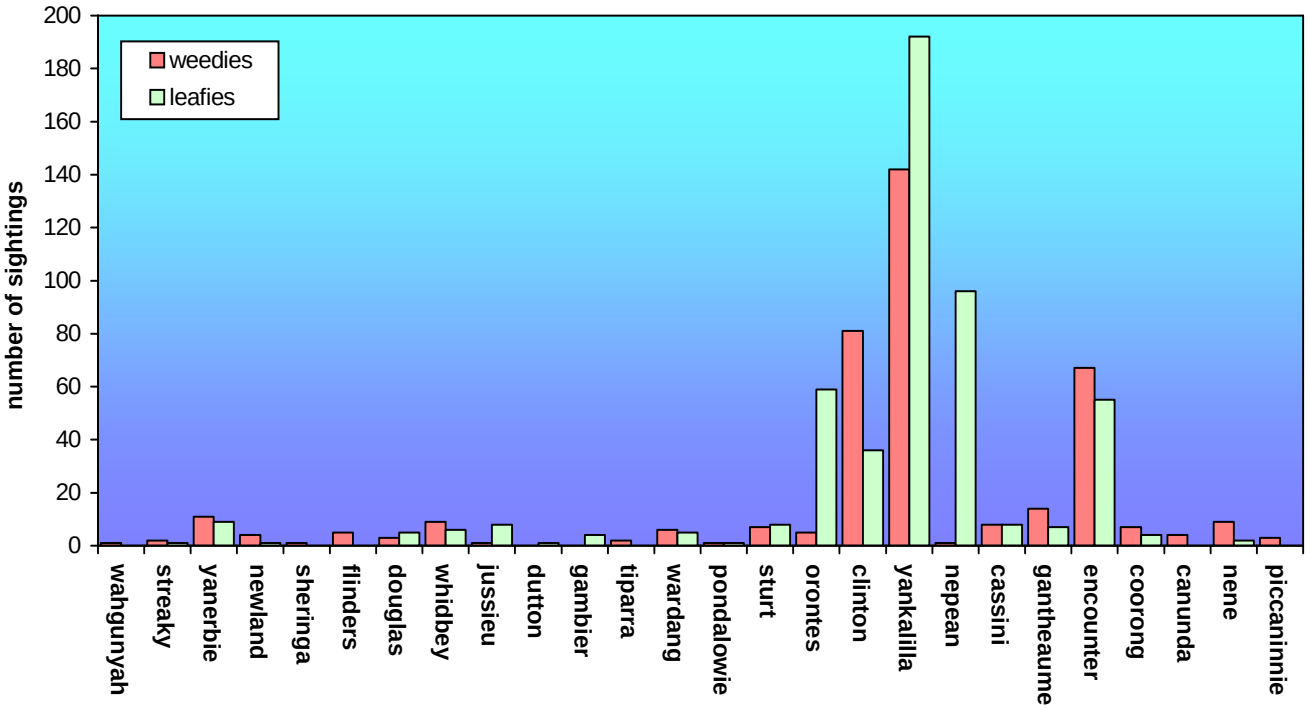


Figure 1a: SA Marine 'Biounit' Distribution of Seadragon Sightings (January 1990 – May 2005).

Biounit sightings in **Figure 1a** above are arranged in approximate order from the western-most biounit in which seadragons have been recorded (Wahgunyah, towards the W.A. border), to the eastern-most biounit (Piccaninnie, in the South East of South Australia). Between January 1990 and May 2005, seadragons have been reported from 26 of S.A.'s 35 biounits. Weedies have been reported from 25 biounits, and leafies from 20 biounits. In the southern Fleurieu Peninsula's Yankalilla Biounit, around 32% of all Dragon Search sightings have been recorded, particularly from the Rapid Bay area. Around 79% of the leafy seadragon sightings and 58% of the weedy sightings from the Yankalilla biounit have been recorded in the Rapid Bay area. Other locations within the biounit from which considerable numbers of sightings have come, include Second Valley (13% of weedy seadragon sightings and 10% of leafy seadragon sightings from that biounit), and an artificial reef off the southern metropolitan area (8% of weedy sightings from Yankalilla Biounit).

The large number of sightings from popular dive spots, as well as repeat sightings from those specific locations, such as Rapid Bay, has influenced the summary statistics regarding *numbers of seadragons* sighted per biounit. Therefore, 33% of the total number of seadragons recorded in the Dragon Search database, came from the Yankalilla biounit, (corresponding to nearly 37% of all leafy seadragons sighted, and 30% of all weedy seadragons sighted).

Between January 1990 and May 2005, 14% of Dragon Search sightings have been recorded from sites in the Encounter Biounit, particularly from the Encounter Bay area (= nearly 87% of sightings in that biounit), with the remainder from the Port Elliot area to the east (6 records); Parsons and Waitpinga beaches to the west (collectively, 8 records); and 1 record from the Cape Jervis area. Of the sightings in the Encounter Bay / Victor Harbor area, 71% were dive records of live seadragons.

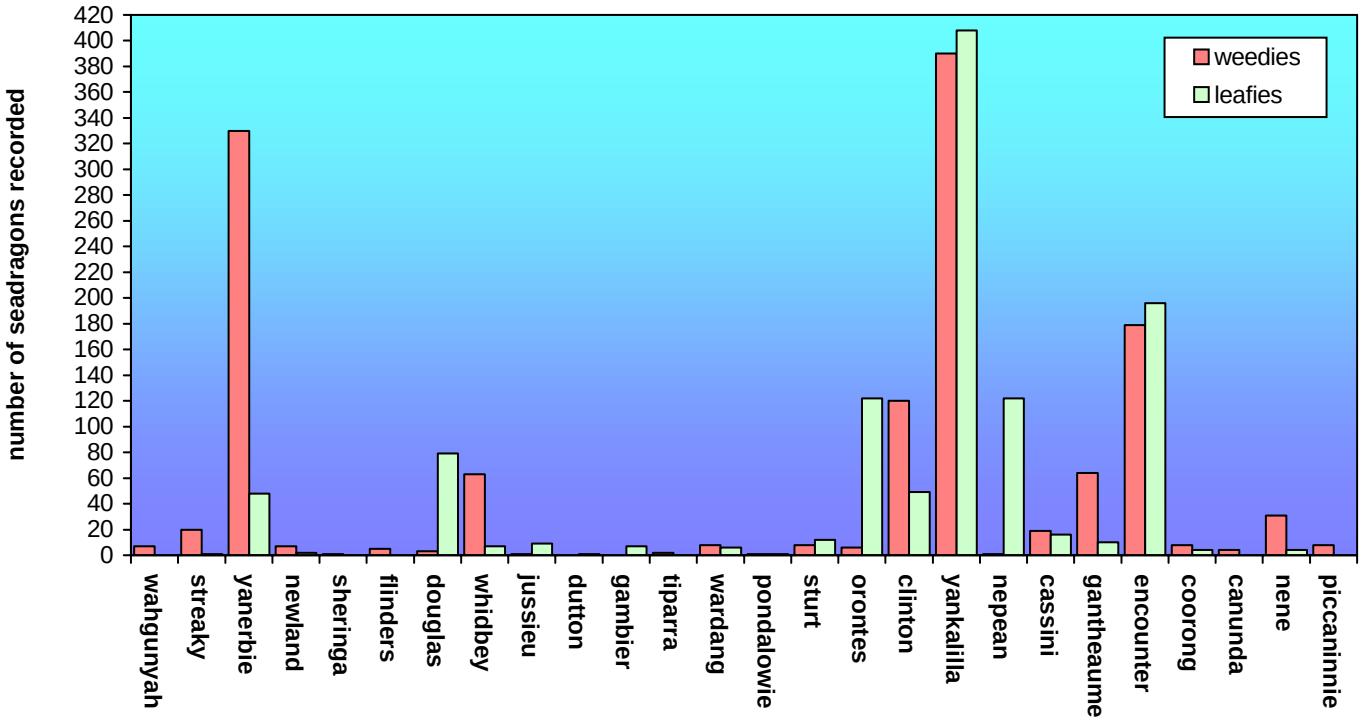


Figure 1b: Total Number of Seadragons Reported from SA Marine Biounits (January 1990 – May 2005)

In the metropolitan area (Clinton Biounit), 14% of all seadragon sightings (and 7% of seadragons) in the main Dragon Search database have been recorded. Within this biounit, around 31% of all sightings (= 30% of weedy sightings and 42% of leafy sightings) by divers have come from reef in the Seacliff area. Eighteen percent of Clinton Biounit records came from patch reefs and the tyre reef off Glenelg, and 8% came from Grange Tyre Reef (all diving records, and almost all were records of weedy seadragons). To May 2005, around 40% of seadragon sightings in this biounit have been beachwash specimens, mainly from Henley (23 records), Brighton (8 records), and Tennyson (5 records).

From north-eastern Kangaroo Island (Nepean Biounit), 12% of Dragon Search sightings have been recorded. All but 1 of those records were sightings of leafies, mainly of single animals and pairs, reported from the Penneshaw area, including repeat sightings. The relatively large number of leafy sightings from that area reflects repeat observations of site-associated leafy seadragons from several sites around Penneshaw. The single weedy sighting to date from the Nepean Biounit was a record from 1997, of an adult weedy caught whilst fishing, east-north-east of Penneshaw.

To date, nearly 8% of all seadragon sightings in the Dragon Search database have been recorded from sites along eastern Yorke Peninsula (Orontes Biounit), the majority of which comprise sightings of leafies from jetties on the western side of Gulf St Vincent. Within that biounit, 3 sightings have also come from the Port Vincent area, 2 from Troubridge Island (both sightings of weedy seadragons), and one from the Troubridge Point area. Very few weedies have been recorded by Dragon Search divers in the Orontes Biounit (i.e. 6 animals, from 5 sightings between 1997 and 2002).

For most biounits, the total number of seadragons recorded matches the number of sightings in terms of proportions between biounits, with several notable exceptions (see **Figures 1a** and **1b**). For example, although only 2% of all sightings have come from the Yanerbie Biounit, these sightings represent 16% of all seadragon specimens recorded in the main Dragon Search database, from January 1990 to May 2005 (see **Figure 1b** above). This anomaly is primarily due to several sightings in which large numbers of dead seadragons, particularly weedies, were recorded in the beachwash (see section on **Beachwashed Seadragons**). It is noteworthy that there is also a record in the historical database of a sighting of "mass" numbers of dead weedies and leafies from the beachwash in this area (i.e. approximately 100 weedies and leafies were washed up at Corvisart Bay ("Back Beach") in the Yanerbie biounit, in January 1987. Similarly, for the Whidbey and Douglas biounits on southern and lower western Eyre Peninsula, the number of sightings was small (2% and 1% of all Dragon Search sightings, respectively), but the number of seadragons recorded was a higher proportion of the total (i.e. from Whidbey, 3% of all seadragons recorded for Dragon Search since 1990, and nearly 4% from Douglas), due to a several sightings of "mass" numbers of seadragons in the beachwash.

The relatively small number of records from southern and western areas of the state does not necessarily indicate that seadragons are less abundant at some locations in those areas, compared with more accessible sites. Indeed, the large number of weedies and leafies that have been recorded in the beachwash at various times from some parts of the West Coast of S.A. (including historical records – see section below), indicates that seadragons are relatively abundant in at least some parts of the eastern Great Australian Bight. The low number of sightings to date from such areas reflects the infrequent diving and beachcombing that have taken place in more remote areas compared with popular dive sites in more accessible locations; near large population centres; and/or sites where Dragon Search is more heavily promoted, or known to the community (e.g. Rapid Bay and other southern Fleurieu locations; Encounter Bay; metro coastal area etc). Furthermore,

much of the West Coast and South East of the state is rarely dived by recreational divers, because the oceanographic conditions in many parts of those regions are not conducive to nearshore diving.

Geographical Limits of Seadragon Sightings in SA database:

1. The most westerly record in the SA database to date comes from the Head of the Great Australian Bight (Yalata region), in the Eucla Bioregion, being a beachcombing report from November 1998, of 7 adult weedies.
2. The most northerly Dragon Search sightings in the database records since 1990 have come from the Port Hughes area, between Tiparra Bay and Moonta Bay in eastern Spencer Gulf, and from Port Neill in western Spencer Gulf. The records from Port Hughes were of an adult weedy sighted in March 1994, and a juvenile weedy sighted during a dive in February 2002. The Port Neill record was a beachcomber's report of a dead leafy, sighted in December 2003. During recent sampling of fish fauna in Spencer Gulf as part of a university research project, weedy seadragons were not recorded any further north than the Moonta area, and leafies were not recorded at all in upper Spencer Gulf sampling (B. McDonald, 2003, pers. comm.). The coincidence is noteworthy, of the most northerly record of weedy seadragons from research sampling and that from Dragon Search reports. However, there is a record in the historic database of 1 weedy and 3 leafies reportedly caught (live) in a trawl at 12m – 20m, at Douglas Bank, upper Spencer Gulf, in November 1985. As the trawls were of short duration (10-15m) and slow speed (4 knots), the reporter considered that the seadragons came from the local area. No other records of seadragons from this far north in Spencer Gulf waters are known to Dragon Search. It is noted that the person who reported this record from northern Spencer Gulf also stated that from Cowell southwards, seadragons are commonly observed, usually in 4-18m water, behind reefs / overhangs. It is possible that although the warm sub-tropical habitat of far northern Spencer Gulf is unlikely to support permanent populations of either of these temperate water species, fast flowing currents south of the area may have driven these seadragons further north, into the Douglas Bank area. There is also a report of leafy seadragons being observed during 1985 – 87 in the bycatch of prawn trawlers operating in reef ledge habitat with sponges, and adjacent seagrass, off the Cowell area, on the mid western side of Spencer Gulf. Also, there is a snapper survey report from 2002, of a weedy seadragon having been observed out of the mouth of Franklin Harbor (i.e. near Cowell). Including the SA Museum record from Douglas Bank (the most northerly sighting reported), the Cowell reports are the second most northerly records to date from Spencer Gulf.
3. In Gulf St Vincent, there are historical reports from benthic surveys during 1965 – 71 (discussed in a separate section in this report) of "numerous weedies being observed between 5m and 15m depth, usually in *Posidonia* and *Amphibolis* seagrass" (S. Shepherd., pers. comm. to Dragon Search 2002), on the eastern side of the upper gulf, from seaward of Outer Harbour, up to the Parham area. On the western side of Gulf St Vincent, during the same survey period 1965-71, seadragons were recorded from deeper gulf waters off Kleins Point (e.g. 10m –15m contour) up to the Muloorwurtie Point area south of Ardrossan, and including the Orontes Bank area off the Port Vincent region. No records from as far

north as those mentioned above have been reported in the current Dragon Search database, 1990 – 2005. On the western side, the most northerly records in the current Dragon Search database come from (i) Dowcer Bluff (an adult leafy caught in a fishing net on shallow reef approximately 2 miles north of Port Vincent); and (ii) a beach at Port Vincent, and a beach north of Port Vincent (both beachcombing records of a single leafy). On the eastern side, the most northerly records in the main database (i.e. since 1990), are all beachwash reports, from Semaphore (3 reports of single leafies), West Lakes (1 weedy) and the Tennyson area (5 reports, 4 of which were single weedies, and one of 6 leafies). The most northerly dive records in the Dragon Search database from the upper eastern side of Gulf St Vincent are all from the Grange Tyre Reef, an artificial reef that was created by the former SA Department of Fisheries to aggregate fish, and it is apparently successful in that role. There are likely to be several reasons for the lack of current records in the Dragon Search database of seadragons reported from as far north as in the 1960s, for either side of the gulf. Firstly, significant changes have occurred to the habitat quality of the gulf since the 1960s (i.e. nutrient-induced seagrass decline on the north-eastern and eastern sides of the gulf, and regular trawling in waters deeper than 10m south of the Ardrossan – Port Prime line), and this damage to habitats may have affected "present day" seadragon abundance in the upper gulf. Secondly, there are very few popular diving spots in the northern gulf (other than the Grange Tyre reef for example, from where 9 seadragon sightings have been reported), and Dragon Search divers do not regularly dive in upper Gulf St Vincent, hence if seadragons are present in the upper gulf, they are not likely to be reported to Dragon Search. Lastly, the upper gulf patch reefs and seagrass beds have not been extensively surveyed for seadragon occurrence in recent times. It would be useful to survey natural patch reefs and the remaining seagrass beds in upper Gulf St Vincent to determine whether the abundance of seadragons observed during the 1960s still exists, or whether habitat changes over the ensuing period have impacted upon the abundance of seadragons. Other site-associated syngnathids in the upper gulf (such as pipefish species) may also have been affected over that time; however historical data are not available. It is noted that survey data on pipefish are now being collected in a number of parts of South Australia, including northern Gulf St Vincent (e.g. Browne, 2004; Smith, 2005, and K. Smith, unpublished data 2004, 2005).

4. To date, the most southerly records for seadragons recorded in the Dragon Search database have come from a beach at Nelson, near the S.A. / Victorian border (1 weedy recorded in the beachwash, June 2001), and from the Port MacDonnell area (a beachwash record of 1 weedy and one diving record of 6 weedies, both sightings from March 2000).

Note that relative abundance of seadragons at each location cannot be determined, due to the non-systematic nature of Dragon Search sightings, which are influenced by diver preference regarding choice of dive site; accessibility of dive site; possible higher promotion and recognition by divers of Dragon Search in metropolitan and other popular diving locations compared with more remote areas, and other factors. Similarly, it is not possible to determine the proportion of sightings per location that are repeat sightings of the same animals or groups of animals. However, as indicated by the sighting numbers in the tables below,

various areas such as Rapid Bay, Second Valley and other Fleurieu Peninsula locations; Encounter Bay; north-eastern Kangaroo Island; jetties off western Gulf St Vincent; and various metropolitan locations such as Glenelg, Henley Beach, and Port Noarlunga; are places where seadragons have been regularly sighted during the past decade of recording. The preponderance of records from these locations is perhaps indicative of regular reporting (from repeated diving) at those sites which are easily accessible; contain popular features for diving (and thus dive groups and clubs also frequent some of those areas), and/or represent sites where seadragons are known to occur. **Maps 2a, 2b, 2c** and **2d** in **Appendix 1** summarise the statewide distribution of weedy and leafy seadragon sightings in 7 of the 8 Bioregions, to May 2005. The tables below also summarise the main locations within 6 of the SA Bioregions where divers and beachcombers have sighted seadragons (including repeat sightings at the same location, from some divers).

Gulf St Vincent (SVG) Bioregion

To date, in the main Dragon Search database there are 687 reports of weedy and leafy seadragons from the Gulf St Vincent Bioregion. Around 77% of those reports came from SCUBA diving during the day; 18% were beachcombing records; almost 3% were night diving records; and less than 2% of records each came from snorkelling, or sightings by other means (e.g. fishing, boating).

Of those sightings from the SVG Bioregion, around 25% have come from Rapid Bay, a very popular Fleurieu Peninsula dive spot where both species of seadragons are known to occur, particularly near the Rapid Bay jetty. Almost 6% of sightings have been reported from the Seacliff area, particularly Seacliff Reef. Another 5% of records have come from Second Valley, also a popular dive area containing a number of small reefs. Around 3% of SVG records have come from the Edithburgh area (particularly from the jetty, another popular dive location). The tables below summarise the main locations within the SVG Bioregion from which weedies and leafies have been reported between January 1990 and May 2005.

Markers	**Total No. of Weedy Sightings for Listed Markers**
Rapid Bay	83
Victor Harbor / Encounter Bay	54
Seacliff	24
Henley Beach	18
Glenelg	17
Second Valley	18
Normanville / Carrickalinga	12
Sellicks Beach	11
Port Noarlunga	11

Markers	Total No. of Weedy Sightings for Listed Markers
Grange	8
Parsons Beach and Waitpinga Beach	7
Western River Cove (KI)	4
Stenhouse Bay	4
Tennyson	4
Hallett Cove	3
Brighton Beach	3
West Beach	3
Edithburgh	3

Around 31% of the SVG weedy sightings to date are beachwash records. Of the 305 sightings of weedies from the SVG Bioregion**,** around 27% have come from diving at the Rapid Bay jetty, a popular location for diving and dive training. Rapid Bay is well recognised as a spot at which leafy seadragons are found, and the results here show that weedies have also regularly been sighted there, with records spanning from the mid-1990's (when reports to Dragon Search began on a regular basis) to the present. Around 18% of weedy seadragon records from the SVG Bioregion have come from dive sites in Encounter Bay and around its islands, as well as a number of beachcombing records near the mouth of the Hindmarsh River, and other sites in the Victor Harbor area. The table above summarises the number of weedy seadragon sightings from each area in the SVG Bioregion, from 83 down to 3 sightings. Two sightings of weedies have been recorded from each of: Somerton in the metropolitan area (a dive record and a beachcombing record); Aldinga Beach (south of metro area); Troubridge Island (off Edithburgh); Marion Bay / Foul Bay area (southern Yorke Peninsula), and Snelling Beach (northern Kangaroo Island).

Within the SVG Bioregion, single sightings of weedies have been reported from each of the following: West Lakes Shore; a site off Kingston Park (metro area); a site seaward of the Marino Boat ramp; a site south of Moana Beach; Port Willunga Beach; Cape Cassini area, Snug Cove area, and east north-east of Penneshaw (the latter 3 areas are all on Kangaroo Island); and "The Gap", in Innes National Park, at the foot of Yorke Peninsula.

Within the Gulf St Vincent Bioregion, the numbers of sightings of leafy seadragons for various locations are listed in the table below, for the period January 1990 to May 2005.

Markers	Total No. of Leafy Sightings for Listed Markers
Rapid Bay	148
Penneshaw area	94
Victor Harbor / Encounter Bay	52
Edithburgh	21
Second Valley	20

Markers	Total No. of Leafy Sightings for Listed Markers
Kleins Point	18
Seacliff	15
Wool Bay	8
Port Giles	6
Brighton / South Brighton	5
Henley Beach	5
Glenelg area	4
Sellicks Beach	4
Aldinga	4
Western River Cove, KI	3
Stenhouse Bay	3
Port Vincent	3
Semaphore / Semaphore Park	3

Within the SVG Bioregion, 454 sightings of leafies have been reported to date, and 33% of these have come from Rapid Bay (mainly the Jetty). Less than 7% of the leafy sightings within SVG Bioregion to date are beachwash records. Around 21% of leafy sightings within this Bioregion have come from reefs and the jetty in the Penneshaw area, mainly from tourist dive trips which seek to view the resident seadragons in that area, and these records include a number of repeat sightings of the same animals on different dates. About 11% of records came from the Victor Harbor / Encounter Bay area, such as “The Bluff” and its jetty (the Bluff is a popular dive spot in the area, and also a site where repeat dives have been undertaken to view resident leafy seadragons); West Island (5 of the 6 records came from a seadragon research project in 1996); the Screwpile Jetty at Granite Island, and other locations in the Encounter Bay area. Encounter Bay is at the south eastern edge of the SVG Bioregion, and is subject to oceanographic conditions more typical of the upper end of the COR Bioregion than many other sites in the more sheltered parts of the SVG Bioregion.

Nearly 5% of leafy seadragon sightings have been reported from the Edithburgh area, particularly the jetty, which has long been a popular spot for dive training and underwater photography. Other jetties around which leafy seadragons have been sighted include those at Kleins Point (4% of leafy seadragon sightings within the SVG bioregion), Port Giles, Wool Bay, and Stenhouse Bay on the Yorke Peninsula. Another 4% of leafy seadragon reports came from dive sites in the Second Valley area, a popular area for dive training and recreational diving. Two sightings each have been reported from Hallett Cove; Seaford Reef; the Port Stanvac dumping grounds; Ochre Point near Maslins Beach; Port Willunga (including the *Star of Greece* wreck); Rapid Head and Carrickalinga / Normanville area on the Fleurieu Peninsula; Kingscote Jetty, Stokes Bay and Snug Cove (on Kangaroo Island); and Stansbury and the Cape Spencer area, both on the Yorke Peninsula.

Single sightings of leafies have been reported from the Grange area; Tennyson Beach and Somerton Beach in the metro area; Kingston Park and Marino Rocks; Myponga Beach; the north side of the Port Noarlunga jetty; Cape Jervis; Waitpinga at the bottom of the Fleurieu; also from Waterloo Bay (near Port Moorowie) and Cable Hut Bay, at the foot of Yorke Peninsula; Troubridge Point near Edithburgh; and the north-west coast of Kangaroo Island (location unspecified).

There are numerous, older, pre-Dragon Search records from the SVG bioregion, of both leafies and weedies. These are discussed in detail in **Part 2** of the report, below.

Eyre (EYR) Bioregion

To date, in the main Dragon Search database there are 77 records of seadragons from the Eyre Bioregion, around 56% of which are beachcombing records, and 44% of which are diving records. Of the sightings that have been reported from the EYR Bioregion, 9% have come from Avoid Bay on the lower Eyre Peninsula; and another 9% from Anxious Bay on mid-western Eyre Peninsula. Around 8% came from the Elliston area, mostly from islands in the Investigator Group, off the mid west coast. Another 5% of records from the EYR Bioregion were beachcombing reports from Bales Beach (Seal Bay, Kangaroo Island). The two tables below summarise the main locations within the EYR Bioregion from which weedies and leafies have been reported to Dragon Search, between January 1990 and May 2005.

Marker	Total No. of Weedy Sightings for Listed Markers
Anxious Bay	6*
Elliston area *(includes offshore Investigator Group of islands)*	6
Coffin Bay / *Coffin Bay National Park*	5
Avoid Bay	5
Seal Bay, KI	4

* (*N.B. Two of the 6 weedy seadragon sightings from the Anxious Bay area were diving records*)

As well as the records listed above, two weedy sightings have been recorded from each of: Sleaford Bay area (southern Eyre Peninsula), Black Point and Hanson Bay (the latter two locations are on Kangaroo Island).

A number of the EYR sightings of weedies have been mass numbers recorded in the beachwash, for example:

- around 250 weedies sighted on Mt Camel Beach in December 1999 (it is noted that previously, 12 weedies were recorded from the same beach in January 1993);
- 30 weedies recorded at Sensation Beach in the Coffin Bay National Park, in March 2002;
- 29 weedies (including 10 juveniles) recorded at Black Point on Kangaroo Island, in December 1999;
- 8 weedies recorded from Vivonne Bay (Kangaroo I.) in December 2001;
- 7 weedies recorded from Flour Cask Bay (near D'Estrees Bay, Kangaroo I.) in November 1998; and
- 6 weedies recorded from Cape Kersaint (Kangaroo I.) in February 1999.

Additionally, there were 20 other beachwash records in which small numbers of weedies were recorded.

Around 50% of the 44 weedy seadragon sightings from the Eyre Bioregion were reports of single specimens, from locations such as:

- coastal beaches and bluffs north of Coffin Bay, on western Eyre Peninsula;
- some of the bays and exposed beaches along the mid west coast / eastern Great Australian Bight;
- Elliston area, and also islands in the Investigator Group (off Ellison);
- West Bay, Pennington Bay, Seal Bay, Black Point, and a coastal dive spot on Kangaroo Island;
- Islands and bays in south-western Spencer Gulf / southern tip of Eyre Peninsula; and
- Innes National Park coast (southern Yorke Peninsula).

Between January 1990 and May 2005, a total of 38 sightings of leafies have been reported from the Eyre Bioregion. In addition to the records in the table below, a number of leafy sightings in the EYR Bioregion have come from Avoid Bay (2 records); and islands off lower western Spencer Gulf / Thorny Passage area (6 records).

Marker	Total No. of Leafy Sightings for Listed Markers
Coffin Bay / Coffin Bay National Park	6
Wedge Island Group	4
Anxious Bay	4
Vivonne Bay, KI	3

As with weedies, a number of the EYR sightings of leafies have been mass numbers recorded in the beachwash, for example:

- Around 75 leafies recorded at Frenchman's Beach in the Coffin Bay National Park, in July 1996;
- 20 leafies recorded at Mt Camel Beach (Anxious Bay) in December 1999. Note that 12 leafies were recorded on the same beach in January 1993, and 6 leafies in January 1990.

To date, there have been 17 other beachwash records of leafies in the EYR Bioregion, in which small numbers were recorded.

On the western side of Eyre Peninsula, single sightings of leafies have come from Baird Bay, and a location 8km south of the Baird Bay inlet; and from Point Westall, north of Sceale Bay. On the Spencer Gulf side of Eyre Peninsula, reports have come from Tumby Bay, a bioregion boundary zone between EYR and SGF bioregions (2 records on consecutive days in June 2002), and Sleaford Bay / Fishery Bay area on southern Eyre Peninsula (2 records, from 1996 and 2003). From the southern Kangaroo Island section of the Eyre Bioregion, reports of leafies other than the 3 Vivonne Bay records, have come from Hanson Bay, Bales Beach (Seal Bay), D'Estrees Bay (4 leafies in the beachwash, in January 1999) and Mouth Flat Beach. A sighting has also been reported from West Cape, at the "toe" of Yorke Peninsula, a bioregion boundary zone. Older, pre-Dragon Search records from the EYR bioregion are discussed below in **Part 2** of the report.

Otway (OTW) Bioregion

To date, there have been few sightings (N = 17, between January 1990 and May 2005) from the Otway Bioregion, around two thirds of which are diving records, and the rest are from beachcombing. The small number of records from this Bioregion may be due to several reasons, such as the fact that (i) the Dragon Search program is better known (and has been more widely promoted) in metropolitan and southern Fleurieu locations compared with regional areas; (ii) much of the South East region is subject to oceanographic conditions and weather that limit dive opportunities, even in limestone reef areas that contain many features of interest to divers; (iii) there are lengthy stretches of wave-exposed sandy substrate along part of the south-east coast, which is of little interest for diving, and (iv) much of the South East region contains a low population density, hence there are fewer people "combing" beaches for washed-up seadragons, compared with more populated areas. The table below summarises the main locations within the OTW Bioregion from which weedies have been reported.

Marker	Total No. of Weedy Sightings for Listed Markers
Gerloff's Bay	5
Blackfellows Caves area	3
Cape Jaffa	3
Port MacDonnell	2

In the South Australian part of the south-eastern Otway Bioregion, between Cape Jaffa and the S.A. / Victoria border, 16 records of weedy seadragons have been reported, including 1 record from the Carpenters Rocks area, in which 2 leafies were also recorded in addition to a single weedy. The Gerloff's Bay records came from repeated dives in the area during spring and summer of 2002. The Port MacDonnell coast is promoted in tourism materials as a good diving destination in the lower South East. The three records from the Blackfellows Caves area are from diving (including one aggregation of 12 adult weedy seadragons sighted in the summer of 1995). One of the records from the Port MacDonnell area refers to an aggregation of 6 weedies sighted during a dive, and the other is a beachcombing record of a single specimen. The 3 records from the Cape Jaffa area are from beachcombing. Apart from those listed above, single sightings have come from Robe, Carpenters Rocks, and Nelson, the latter near the S.A. / Victorian border.

To date, in the main database there have been 2 reports of leafies from the S.A. portion of the Otway Bioregion, both recorded in the same season (summer of 1995-96, from December to February). The reports are from Nene Valley and Carpenters Rocks, and 2 adult leafies were recorded in each sighting. A weedy seadragon was also recorded in the Carpenters Rocks sighting.

In the "historical" database of older, pre-Dragon Search records, Otway Bioregion sightings include an undated record from beachcombing at *Nora Creina Bay* (1 adult seadragon with eggs observed), 1 record from *Robe* (a weedy recorded in the beachwash, in August 1922), and 2 records from *Carpenters Rocks* (2 leafies and 1 weedy observed during dives in June 1980). (See **Part 2** of the report).

Spencer Gulf (SGF) Bioregion

To date, only 14 records (in the database since 1990) have come from the SGF Bioregion. Six of these records were from the Hardwicke Bay area, such as Bluff Beach (3 records), and all 6 records from that area are beachcombing reports, comprising 2 sightings of leafies and 4 sightings of weedies. Other records from Spencer Gulf have come from:

- Point Turton area: 3 records, including a weedy sighting by a snorkeller; and 2 dive reports (one of 2 weedies and the other of a single juvenile leafy); and
- Port Hughes area (1 juvenile weedy sighted February 2002, and 1 adult weedy sighted March 1994).

Single sightings have come from Port Victoria (1 juvenile leafy), and Port Neill (a beachcombing record of an adult leafy, sighted in December 2003). There is also a fishing record of an adult leafy caught in a trawl off Corny Point, a bioregion boundary zone. Additionally, in 2002, during a snapper survey in Spencer Gulf, a weedy seadragon was recorded outside the mouth of Franklin Harbor (SARDI data, 2003).

In the "historical" database of older, pre-Dragon Search records, Spencer Gulf (SGF) Bioregion sightings have come from *Tiparra Reef* (numerous leafies), *Port Victoria* (1 weedy observed February 1985; 1 leafy observed January 1981), *Wallaroo* (1 weedy in the beachwash, July 1936), *Corny Point* (1 weedy observed April 1988), and *Port Minlacowie* (1 leafy in the beachwash, May 1932). These are discussed in more detail below, in **Part 2** of the report.

Murat (MUR) Bioregion

Between January 1990 and May 2005, only 10 reports from the MUR Bioregion on the upper west coast of S.A. were recorded in the Dragon Search database. Eight of the 10 records from that Bioregion were beachcombing records. Half the reports came from the summer of 1999. Four of the 7 records of weedies have come from Back Beach (Corvisart Bay, south of Streaky Bay); one is from Smooth Pool; one from south of the Haslam Jetty (also in the Streaky Bay area), and one from Smoky Bay. Several leafy seadragons were also reported in one of the Corvisart Bay sightings of weedies (from January 1999). There is also a record of a single leafy seadragon, washed up at Corvisart Bay (from March 1995). In total, 5 of the 9 seadragon sightings in the Murat Bioregion have come from that Back Beach area in Corvisart Bay, and a number of these sightings, comprising aggregations of beached specimens, are discussed further in the section below on **Beachwash** reports. Regarding the SCUBA records, sightings of a single leafy seadragon have been reported from Smoky Bay (May 1996), and from a reef site near Corvisart Bay (January 1992). As with the Otway Bioregion, the MUR Bioregion encompasses more remote parts of SA, including fairly inaccessible coastal locations, and is a region where fewer divers and beachcombers are present, compared with metropolitan and southern Fleurieu locations.

Marker	**Total No. of Weedy Sightings for Listed Markers**	**Total No. of Leafy Sightings for Listed Markers**
Corvisart Bay	5	3
Streaky Bay	1	0
Smoky Bay	1	1

In the "historical" database of older, pre-Dragon Search records, Murat Bioregion sightings have come from *Fowlers Bay* (2 records of single leafies, recorded in February and June 1986); *Rocky Point* near Ceduna (a single leafy) and Corvisart Bay / "Back Beach" (one record of approximately 100 leafies and 100 weedies found on a beach in January 1987). These are discussed in more detail below, in **Part 2** of the report.

Coorong (COR) Bioregion

In the main Dragon Search database, there are 18 records from the Coorong Bioregion, and all except 1 are beachcombing records. Other than the records listed below for various markers, a single sighting has come from a beach 4km south of the Murray Mouth (1 juvenile weedy, sighted November 1998). Port Elliot is a boundary zone between the eastern edge of the SVG bioregion and the northern end of the COR Bioregion, and is included in the Coorong section for reporting purposes, because, like Encounter Bay, the area experiences oceanographic conditions not typical of most parts of the SVG Bioregion.

Marker	**Total No. of Weedy Sightings for Listed Markers**	**Total No. of Leafy Sightings for Listed Markers**
Port Elliot	7	1
Goolwa	3	1
Middleton	2	2
Kingston	0	1

In the "historical" database of older, pre-Dragon Search records, COR Bioregion sighting include 1 weedy recorded in the beachwash at the *Coorong* (April 1936), and 1 weedy recorded in beachwash at *Port Elliot* (SVG / COR boundary area) in February 1937. (See **Part 2** of the report, below).

3. Sighting Details

***Seasonal Summary of Sightings*: Figure 2** below shows a monthly summary of seadragon sightings to May 4th, 2005. Month was recorded for all but one sighting between January 1990 and May 2005. Excluding records in which seadragons were not seen, around 43% of all sightings were made during the summer months, 24% of sightings were recorded in autumn, almost 13% in winter, and 20% in spring. Similarly, for records by diving, snorkelling and other means (i.e. excluding beachwash records), 41% of sightings occurred in summer, 25% in autumn, 13% in winter and 20% in spring.

Weedies: Around 41% of weedy seadragon sightings were made during the summer months, 26% of sightings were recorded in autumn, approximately 11% in winter, and 22% in spring.

Leafies: Around 44% of leafy seadragon sightings were made during the summer months, 22% of sightings were recorded in autumn, 14% in winter and 20% in spring.

Neither relative frequency nor abundance of seadragons per sighting location can be meaningfully discussed on a seasonal basis due to the non-standardised nature of the recording, which is affected by a number of factors. These include (i) uneven distribution of recordings over space and time (i.e. areas were not systematically surveyed for seadragon presence, at all times of the year); (ii) individual preferences in the locations and seasons in which recorders chose to dive or go beach-combing (e.g. from late spring through to early autumn is a popular period for diving, because the water is warmer than at other times of the year, and summer is particularly popular, accounting for close to half of all the records by diving, snorkelling and other means); (iii) weather and/or sea conditions, and (iv) other opportunistic and/or uncontrollable aspects of the recordings. Apart from the smaller number of recreational dives that are taken in winter (which is a major factor biasing any seasonal summary of sightings), it is possible that after the breeding season, seadragons in some areas move offshore into deeper water (Kuiter, 2000, 2003), which may also reduce the frequency of sightings during winter. Other factors influencing the seasonal summary of sightings are discussed below. Despite these caveats, monthly distribution of seadragon sightings provides important supporting information when assessing seasonality of breeding, as discussed in the section below on **Brooding Male Seadragons.**

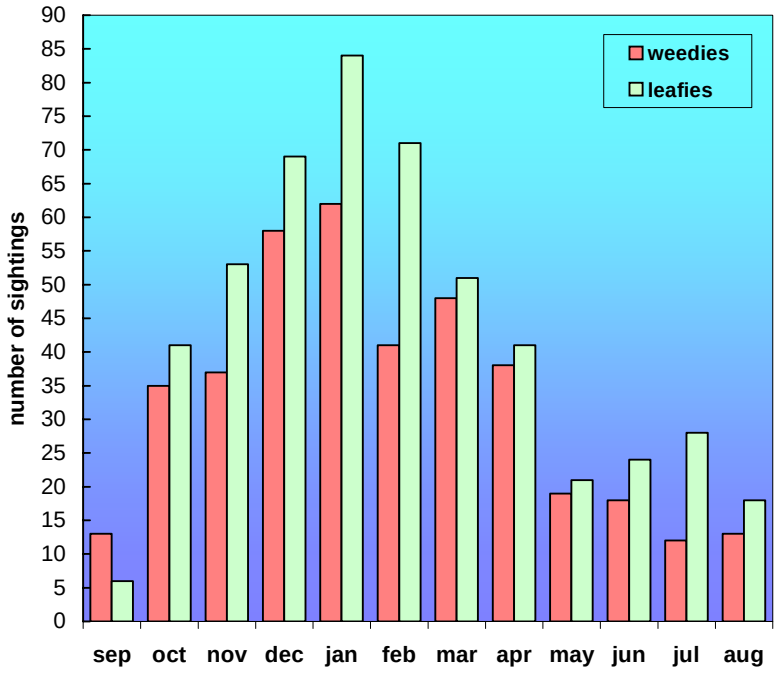


Figure 2: Monthly Summary of Seadragon Sightings, to May 2005

Summary of Sighting Modes:

To date, around 70% of all seadragon sightings (and around 56% of the total number of seadragons sighted, including repeat sightings), have been recorded by *SCUBA* dives during the day; 2% of sightings were made during night diving (representing 6% of the total number of seadragons sighted, due to one very large aggregation observed during a night dive); almost 25% of all records were from *Beachcombing* (representing around 36% of the seadragons recorded); only 1% of sightings were

recorded during *Snorkelling* (around 0.5% of seadragons sighted), and by *Other* means (1% of sightings; and less than 0.5% of the number of seadragons sighted).
The large percentage of seadragons sighted by beachcombers, relative to the number of sightings by that mode, reflects the fact that aggregations of dead animals (including large numbers, in some cases) were reported in some of the beachcombing records, which boosts the total number of seadragons sighted by that mode. Beachwash records are discussed in detail, in a separate section of this report.

Twenty seven percent of the 584 day SCUBA diving records came from *Rapid Bay*, a popular southern Fleurieu dive area where "resident" seadragons are well known to occur in the vicinity of the long jetty. Sixteen percent of day diving records came from the *Penneshaw* area on north-eastern Kangaroo Island, which contains a number of sites (including the jetty, and nearshore reefs in the Penneshaw area) that are also recognised as "resident" seadragon habitat, and the subject of regular recreational and tourism dives for viewing seadragons. Data from repeated, targeted dives within the area, particularly during 1997 and 1998, have been submitted to Dragon Search; hence the comparatively large number of records from the Penneshaw area. Similarly, the 12% of dive records from headland and reefs in the *Victor Harbor / Encounter Bay* area reflects the popularity of that area for dives in seadragon habitat. A number of repeat sightings of the same group(s) of dragons have come from the Bluff area. *Second Valley* is another popular southern Fleurieu spot that attracts divers, with a number of small bays and reefs (including "bommies") supporting high diversity of fish and invertebrates, and 6% of day diving records in the main Dragon Search database have come from the Second Valley area. Another 6% of day diving records have been reported from *Seacliff Reef*, a popular metropolitan diving location, particularly for viewing Western Blue Devil fish, and also promoted recently in South Australian Tourism literature, as a "dive trail" in which divers can possibly view seadragons. Repeat sightings over time have been recorded from a number of jetties and tyre reefs on both sides of Gulf St Vincent. Examples include several jetties at on the Yorke Peninsula side of Gulf St Vincent; as well as the tyre reefs in the central and southern metropolitan coastal area. In addition to the tyre reef, other locations in the Glenelg area, such as the Barge and Dredge wrecks, are also quite popular for diving, and patch reefs in the area also used by divers (as well as recreational fishers). The collective number of day diving records from all sites in the Glenelg area account for almost 4% of the total. Examples of other locations from where SCUBA divers have recorded seadragons on a number of occasions, and submitted several records to Dragon Search, include Avoid Bay on the west coast of S.A.; two islands in the Investigator Group (off Elliston); two coves off northern Kangaroo Island; two islands at the bottom of Spencer Gulf; reefs in the Carrickalinga / Normanville area; and Gerloff's Bay and Blackfellows Caves area in the lower South East of S.A..

There are 18 night diving records in the Dragon Search database, 8 of which have come from the Rapid Bay jetty; 3 from the Encounter Bay area; 2 each from Seacliff Reef and the Port Noarlunga Tyre Reef; 2 from the Edithburgh Jetty area, and 1 from Marino Rocks. To date, a small number of snorkelling

records (N = 11) have been reported, 10 of which have come from the SVG Bioregion. The snorkelling records comprise 4 reports from the Rapid Bay jetty; 2 each from Second Valley and the Bluff in Encounter Bay, and 1 each from two jetties on eastern Yorke Peninsula. There is also a snorkelling record from Carrickalinga in which juvenile seahorses were seen, but not seadragons.

Records by *Other* sight modes (N = 9) include several fishing records, such as the following reports:

- from December 2001: a leafy caught in a net (and released alive) by a fisher at Dowcer Bluff, a reef about 2 miles north of Port Vincent;
- from April 1997: a weedy floating on the surface (possibly with newly hatched young), observed by a fisher operating east-north-east of Penneshaw;
- from June 1995: an adult leafy caught during trawling off Corny Point; and
- from January 1995: a leafy adult tangled in fishing line, at Stansbury Spit.

A number of other records for which *Other* sighting mode was specified, include seadragons seen floating on the water surface in the shallows. Examples include:

- a dead weedy sighted floating under the jetty at Marion Bay ("foot" of Yorke Peninsula), in April 2000, after a storm with strong winds and swell;
- a juvenile weedy (3cm long) found in a shallow rock pool at Victor Harbor (Encounter Bay), in November 2000;
- a juvenile weedy seen (by a wave skier) floating on the water surface, 50m offshore from the south bay at Carrickalinga, in January 1999;
- a freshly dead leafy adult found floating on the surface, near a boat, at Cable Hut Bay ("foot" of Yorke Peninsula), in February 1997; and
- a dead leafy adult found floating in seaweed on the water surface, at the Screwpile Jetty (Encounter Bay) in December 1997.

4. Habitat Details

To date, habitat type has been specified for around 78% of the 622 sightings by the applicable modes (*day diving, night diving, snorkelling, other means*), totalling 485 records, and 1218 seadragons, including repeat sightings in the same habitats, and also including several aggregate records and sightings of large groups of seadragons. In the S.A. database, bottom type and habitat type are combined into a single field with overlapping categories, resulting in a number of different combinations of bottom type and habitat recorded. There appeared to be some lack of standardisation in the recording of bottom type and habitat details, and there were also a number of mixed habitat types and *other* habitats recorded. Percentages in the discussion below do not sum to 100 due to the overlap between habitat and bottom types, and the number of different combinations of habitat type recorded. Notable results to date include the following:

Sand: Around 35% of the sightings by the applicable modes for which habitat was recorded, reported *sand* amongst the habitat details (i.e. "Habitat" or "More Details about Habitat" categories, representing 41% of all seadragons recorded by diving, snorkelling or *other* means). These records included sandy bottom areas dominated by seagrass, as well as mixed habitats of sand/seaweed; sand/seaweed/reef; seagrass/sand/reef; seagrass/rubble/sand; seaweed/rubble/sand; and granite or limestone patch reefs (often covered with seaweed) in sand. There were also several records listing sand/rubble with no cover specified. Most records for which sand was listed also contained other cover in the vicinity, such as seagrass (see below), seaweed or reef patches. This is expected, considering that (i) bare sand habitats are of less interest to divers, and thus fewer records come from such areas, irrespective of other factors; (ii) lack of food availability for seadragons is possible over large stretches of bare substrate; and (iii) seadragons may prefer vegetated habitats as a means of camouflage. Approximately 38% of the records for which sand was specified as a main cover (usually with seagrass) came from the Rapid Bay jetty area, and almost 15% of such records came from locations in the Victor Harbor area (i.e. Encounter Bay and islands). Other locations in which sand was a dominant cover included places such as the jetties in western Gulf St Vincent; the tyre reefs in the metropolitan area; and Seacliff Reef. Only 4 of the 171 records in which sand was specified, listed sand only with no other habitat details, and all 4 were from Rapid Bay jetty.

Seagrass: Related to the above (sand bottom habitat), is the incidence of records from *seagrass*-dominated habitats, or mixed habitats containing seagrass, representing 40% of all sightings by the applicable modes. About 48% of records for which seagrass was specified in the cover, came from the Rapid Bay area (mainly the Jetty); 8% of records came from a jetty in mid-western Gulf St Vincent / eastern Yorke Peninsula; and about 7% of seagrass habitat records were each reported from the Victor Harbor area (e.g. jetties and reefs in Encounter Bay, and also West Island), and from the Edithburgh Jetty. Another 5% of records for which seagrass were specified came from reefs in the Second Valley area, and also 5% came from Seacliff Reef; and 5% of records came from grain jetties near the "heel" of Yorke Peninsula. Because seagrass usually grows on sand, it is not surprising that nearly 50% of the seagrass records also specified sand in the "Habitat" category. Around 17% of the seagrass records specified only that cover, with no other habitat details provided. Rubble was listed as part of the habitat in 22% of the seagrass records, and around 8% of the seagrass records listed both sand and rubble/stones as part of the seagrass habitat. A large number of habitat records in which seagrass was present, also contained seaweed (28%). Other mixed habitats in which seagrass was present included those described as: seagrass/seaweed/rubble; seagrass/seaweed/reef; seagrass/reef, and seagrass/seaweed/reef. To date, there have been 95 sightings of weedies in habitats containing seagrass, around 63% of which have come from Rapid Bay jetty; about 8% have come from sites in the Victor Harbor area; 6% from the Second Valley area, and 5% each from Seacliff Reef and reefs in the Glenelg area, which have seagrass in the vicinity. One hundred and fifty two sightings of leafies in seagrass habitats have been recorded, and most have come from (in descending order): Rapid Bay; several jetties along the "heel" of Yorke Peninsula, and Seacliff Reef, in the metropolitan area. A small number of records

specified the genus of seagrass, and 3 genera were recorded: *Posidonia* (commonly known as "tapeweed" or "ribbon weed"), *Amphibolis* ("wireweed") and *Halophila* ("paddleweed").

Seaweed and/or Reef: A large number of records of both weedies and leafies came from both *seaweed*-dominated and/or *reef*-dominated habitats. Around 54% of sightings by the applicable modes specified *seaweed* as part of the main cover, or as part of the other habitat details provided; 40% of such sightings specified *reef* (excluding artificial / tyre reefs) and collectively, around 29% of records specified both *seaweed* and *reef* as part of the habitat. For weedies, 44% of sightings listed *seaweed* as a descriptor under habitat type or other habitat information, and 47% listed *reef*. Around 24% of weedy sightings for which habitat was specified listed both *reef* and *seaweed* as part of the habitat. For leafies, 58% of sightings listed *seaweed* as a descriptor under habitat type or other habitat information, and around 34% listed *reef*. Around 31% of leafy sightings listed both *reef* and *seaweed* as part of the habitat. Seaweed-dominated reef areas in which weedies have been sighted include, for example, an abalone fishing site in the Investigator Group of islands, and a site in Avoid Bay on the West Coast (the latter specifying low calcareous reef with *Ecklonia*); one of the coves on northern Kangaroo Island (dominated by a dense cover of mixed brown canopy macroalgae); a number of reefs in the Encounter Bay area; reefs at Second Valley; parts of the Rapid Bay Jetty area (*but see also section below on Rapid Bay*); Seacliff Reef; and reef overhangs and "bommies" at several locations in the lower South East. For leafies, seaweed-dominated habitats and other reef habitats in which leafies were recorded on a number of occasions include coastal reef sites in the lower South East of S.A.; coves and rocky bays on northern Kangaroo Island; a number of popular dive sites on north-eastern Kangaroo Island (a large number of repeat sightings have been recorded from that area); islands in Thorny Passage, and south of Spencer Gulf; coastal reefs outside of Coffin Bay on the Eyre Peninsula; headland and island sites in the Victor Harbor / Encounter Bay area (in particular, repeated sightings have come from the Bluff area); locations in the Second Valley area; reefs off the Carrickalinga / Normanville area; and reefs at Aldinga, Seaford and Seacliff. Additionally, a number of sightings in the historical database came from abalone research surveys in various parts of the state, from the late 1960s to the 1980s, and general habitat details were provided: "*Seadragons were usually observed in Cystophora and Sargassum communities (often also with Scytothalia or Seirococcus), and at the junction of these algal communities with seagrass (Heterozostera; Amphibolis and/or Posidonia), in places of current flow, but reduced surge / swell*" (S. Shepherd, pers. comm. to Dragon Search, 2002).

Kelp: Both weedy and leafy seadragons were recorded from habitats containing *kelp*, which accounted for 6% of all sightings for which habitat details were provided, and 12% of all seadragons sighted by the applicable modes. Almost all records for which kelp was specified are likely to refer to *Ecklonia radiata*, considering the geographical distribution of those records. There is one exception, from a bay in the lower South-east, where giant kelp (*Macrocystis angustifolia*) was recorded on "bommies", with seagrass on sand between the reef outcrops. The lower south-eastern part of S.A. is part of the distribution of *Macrocystis*, which is a cool water genus. There are two species in south-eastern Australia, one of which occurs in South

Australia. For all of the records in which kelp was specified, other habitat descriptors were also provided (e.g. other seaweed present; reef; seagrass; sand; rubble, and combinations of those). Examples of sites at which kelp was reported to be one of the dominant covers included the Bluff in Encounter Bay; sites at Second Valley; Seacliff and Seaford; northern Kangaroo Island; and islands off southern Yorke Peninsula.

Rubble: To date, around 19% of records for which habitat was specified, have included rubble as a feature, as either the main habitat type or as part of a habitat of mixed features or *other* habitat type (e.g. containing sand, seaweed, reef, seagrass, and combinations of those). Of the 92 records listing rubble, two thirds came from Rapid Bay. Rubble bottom was also recorded at an island in Thorny Passage, and in the vicinity of 4 jetties in south-western Gulf St Vincent / "heel" of Yorke Peninsula area; Kingscote Jetty on Kangaroo Island (where sand and mud also recorded); various nearshore reefs in the Victor Harbor area; the dumping ground at Port Stanvac; Seacliff, and a site off Kingston Park in the metropolitan area, and a number of other locations.

Other Habitat was specified for around 5% of sightings, and was also included with one of the main habitat descriptors (sand, seaweed, seagrass, rubble etc) for an additional 8% of records. Examples for which *Other Habitat* was recorded included jetty pylons (e.g. at Rapid Bay); boulders in the Encounter Bay area; recesses in rock, also in Encounter Bay area; car tyre reefs in the metropolitan area; a sighting near a single car tyre (Rapid Bay); and a sighting over a car body wreck (Stenhouse Bay). Other records included a shallow rock pool (near Granite I. in Encounter Bay); a scallop bed (Seacliff); "broken bottom" (i.e. probably calcareous reef) off Marino; a rock outcrop on a gravel bottom (Rapid Bay), and a record of a seadragon floating on the surface in a bay south of Carrickalinga, for which no habitat details were provided. Two records for which *Other* was specified as the main habitat type, provided no details. Records for which *Other Habitat* was additional to one of the main descriptors mainly included jetty pylons / structures and car tyre reefs.

Mud: There was 1 record from a shallow, mud bottom habitat (Kingscote Jetty, KI), which also contained some sand and rubble.

Other notable habitat details included the lack of consistency in the recording of habitat type in the vicinity of the Rapid Bay Jetty. For the 147 records from this area for which habitat details were provided, the following summarises the main habitat descriptions provided for this jetty:

- Seagrass / Sand (10%) or Sand / Seagrass (7%)
- Seagrass (12%)
- Seagrass / Rubble (7%)
- Rubble (7%)
- Rubble / Seaweed (or Rubble / Seaweed / Other) (5%)
- Seagrass / Seaweed (5%)
- Sand / Rubble (3%)

- Sand (3%)
- Seaweed (4%)
- Seagrass / Sand / Rubble (or Sand / Seagrass / Rubble) (nearly 5%);
- Seagrass / Rubble / Seaweed (4%)
- Sand / Rubble / Seaweed (nearly 3%)

plus various other combinations of the above e.g. Sand / Rubble / Seaweed / Reef (3 records); Seagrass / Other (3 records); Sand / Seagrass / Seaweed (3 records); Seaweed / Sand (2 records); Sand / Rubble / Seaweed / Reef (3 records), and a number of other permutations. Seadragons have also been observed in the vicinity of jetty debris, and "structures" associated with the jetty, and also near rubbish at the Rapid Bay jetty site. For example, 1 sighting reported that a seadragon was hovering over beer bottles that had been put inside a tyre near the jetty.

5. Behaviour

To date, behaviour has been recorded for around 1089 seadragons (within 404 records), including repeat sightings, and sightings of groups. No behaviour was recorded for around 28% of animals sighted by the applicable methods (day and night diving, snorkelling, or *other* sighting modes), including sightings of seadragon aggregations. The table below summarises the main behaviours observed for individuals and groups of seadragons, as a percentage of the sum of the number of seadragons for which behaviour was recorded.

Main Behaviour Observed	**% of Seadragons for which Behaviour was Recorded**
Hovering	48
Hovering / Swimming	17
Swimming	13
Other	10
Feeding	6
Feeding / Swimming	2
Feeding / Hovering	1
Reproduction / "Egg Transfer"	(1 record)

- As shown in the table above, around 50% of the seadragons for which behaviour was recorded, were *hovering*.
- In 13% of records (representing around 17% of seadragons for which behaviour was recorded), both *hovering* and *swimming* were specified, because in most of these cases more than 1 seadragon was observed, and their separate behaviours were therefore recorded.

- There are 22 records to date for which *feeding* is specified as the main behaviour, and several more specify *feeding and hovering*, or *feeding and swimming* (usually more than one seadragon observed in these cases). For both species, feeding was observed in both seaweed-dominated habitats (such as macroalgae-covered reefs) and seagrass habitats (e.g. *Posidonia* beds; *Amphibolis* beds). Groups of weedies and single weedies have been observed feeding in various habitats (e.g. over seaweed-dominated reefs, artificial tyre reefs, and other reefs; seagrass beds with sand or rubble bottom; and mixed seaweed / seagrass habitats). Similarly, leafies have been observed feeding in both seaweed-dominated (e.g. *Ecklonia*, and species of *Cystophora* and *Sargassum*) reef habitats; seagrass habitats and mixed seaweed / seagrass habitats. In two cases, weedies and leafies were seen feeding together, in mixed habitat with seaweed, seagrass, and sand or rubble.
- There was one record of 2 leafies observed courting, leading up to "linking at the hips", and *egg transfer* was recorded as the behaviour type, although it is uncertain whether the actual transfer of eggs from female to male was observed.

There were 36 records of *other* behaviour, three of which specified that the seadragons were *hiding* (in an artificial reef; a seaweed-covered reef, and in a seagrass bed); and 4 of which listed the seadragons as *resting*, including a small number of seadragons that were sighted lying on their side, on the bottom. Other examples of *other* behaviour include a weedy hatching eggs; a weedy rolling on its side whilst feeding; 2 out of 3 egg-bearing male weedies sighted swimming together; a leafy ascending jetty pylons and feeding; a leafy circling in the water column (with a sea louse imbedded in its head); a leafy being nipped by a trevally fish at a jetty site where fishing bait was being dropped into the water; a leafy "sheltering against reef"; a leafy caught in fishing line, and a leafy captured in a net (and released). Most other records which specified *other* behaviour referred to more than one seadragon (e.g. adults and juveniles, or weedies and leafies seen during the same dive), each engaged in a different activity (e.g. feeding, hovering, swimming).

6. Seadragon Groups and Singles

Repeat Sightings: Groups of weedies have been recorded at a number of locations in several bioregions. It is possible that some of these records represent repeat sightings of the animal(s), or the same members of loosely structured seadragon groups, recorded either during the same day, or, in the case of some groups, within a few days of the previous dive. Some of the numerous examples of similar records include the following, in descending chronological order:

- 2 records of a pair of leafies, sighted at different depths on the same day (26th March 2005), at Stenhouse Bay;
- Records of 4 weedies and 2 weedies, recorded at a bay in the lower South East of S.A., on 15th and 13th December 2002 respectively, and a group of 6 weedies also recorded on the 13th December 2002 at the same location, at the same depth;

- 2 records from Tumby Bay in June 2002, one day apart, in which 1 adult leafy was sighted under the jetty;
- A group of 2 adult weedies plus 4 juveniles, and a group of 1 adult plus 3 juveniles, sighted a week apart at a similar depth at Rapid Bay, in October 2001;
- 2 records of 5 adult weedies observed 2 days apart, both at 11m depth, at Rapid Bay jetty in July 2000;
- 4 reports from Avoid Bay, between the 10th and 22nd of January 1999, in which various numbers of weedies (ranging from 3 to 11 animals) were recorded between 6m and 10m;
- Reports of 11 weedies and 7 weedies, recorded at the same depth (10m) at Rapid Bay, on 24th and 20th January 1997 respectively; and
- Reports from Noarlunga Tyre Reef of 2 adult weedies sighted at the same depth, on 2nd and 9th January 1991.

Consistency of Sightings Over Time: It is noteworthy that various sized groups of seadragons seen at particular locations, were often recorded over a number of years in the database, which indicates the ongoing importance of such areas as habitat for "resident" groups of seadragons. Some examples include:

- A group of 3 weedies observed at Avoid Bay in 1996, and several sightings of groups in January 1999 (3, 4, 4, and 11 weedies);
- Pairs or small groups of leafies observed at a grain jetty in western Gulf St Vincent in 1997, 2001 and 2002;
- A large group of leafies (13 animals) observed at a south-western Gulf St Vincent jetty in 1994, and a small group (4 animals, including a juvenile) and a pair observed in 2000;
- Groups of weedies observed at the Grange Tyre Reef in 1997 (2 sightings, of 2 animals and 11 animals), 1998 (8 animals), and 2001 (3 animals);
- pairs of weedies observed at Glenelg Tyre Reef in 1995, 1997, 1998 and 2001;
- Pairs and/or small groups of weedies or leafies recorded from Seacliff Reef, in most years between 1992 and 2003 (rarely with both species recorded together);
- Singles, pairs and groups of weedies (with groups ranging from 3 to 20 animals) and leafies (groups of 3 to 16 animals), regularly observed at Rapid Bay:- there are groups of both species recorded for almost years between 1996 and 2005;
- Pairs and/or small groups of leafies observed at Second Valley in 1996, 1998 and 2000;
- Records of groups of leafies from the Bluff, Encounter Bay, dated 1991 (3 records, of 12, 5 and 3 leafies); 1994 (a record of 100 leafies observed whilst the recorder was diving at night); 2001 (3 records of leafy groups, comprising two groups of 2, and one group of 9), and 2002 (2 sightings of 7 animals recorded one month apart, which likely refers to the same group);
- Pairs and small groups of weedies observed at various reefs in Encounter Bay, between 1998 and 2001, and there were sightings of weedies at an island location in Encounter Bay, in 1993, 1997, 1998, 2000 and 2005;

- A group of 3 weedies sighted at a popular coastal diving spot on northern Kangaroo Island in 1995, and another group of 10 weedies sighted in 2001;
- Pairs and/or small groups of leafies observed at a dive spot in the Penneshaw area on Kangaroo Island, at various dates in 1995, 1997 and 1998; and
- A group of 12 weedies observed at a nearshore reef site in the lower South East of S.A. in 1995, and pairs of weedies observed in the area in 2002 and 2003.

For some areas, records of groups are restricted to 1 or 2 years of recording, in some cases with few or no recent records. One example is the groups of weedy seadragons observed at Noarlunga Tyre Reef – there are 10 records of various sized groups (ranging from 2 to 12 animals) recorded during the summers of 1990/1991 and 1991/1992, but there is only one more recent Noarlunga Tyre Reef record in the database, that being a single weedy recorded in 1999. Due to the opportunistic nature of the recording (i.e. locations are not systematically surveyed over specified time periods), no interpretation can be given regarding the lack of recent Dragon Search reports of weedy groups from the area; however it is noted that local divers report seeing weedy seadragons regularly on this reef.

It is not possible to determine from the Dragon Search sightings whether seadragons sighted at any particular location over a several year time period were the same individuals. Given that both weedy and leafy seadragons can live for more than 10 years (Kuiter, 2000, 2003), and recent work using mark-recapture techniques has shown that leafies have a strong degree of site fidelity (Connolly et al., 2002), it is possible that a number of the Dragon Search sightings over several years refer to the same adult animals. The recent work by Connolly et al. (2002) on leafy seadragon abundance and movement at West Island in Encounter Bay (South Australia), showed that around 9 seadragons were recorded in 47 dives (comprising 45 sightings), over a 14 month period. The seadragons did not move far from their “home” range (of around 35m – 82m), although there was some movement of animals out of the study area (a 100m stretch of coast on the north-western side of West Island, Encounter Bay), since even the most frequently sighted seadragon was only seen on 25% of the dives (Connolly et al., 2002). Similarly, recreational divers who dove regularly at Encounter Bay and the Penneshaw area on Kangaroo Island have recorded individual seadragons by their size, pattern and coloration, and some divers have recorded the same individuals from the same areas over various time periods (e.g. at a scale of months).

The largest groups of weedy seadragons recorded in the Dragon Search database have been an aggregation of 20 weedies (including 18 juveniles) recorded at 10m at Rapid Bay during a dive in March 1999; and an aggregation of 16 weedies (including 12 juveniles) recorded at 10m during a dive, also at Rapid Bay, in January 1999. These and other records are detailed in the table below, which summarises the locations of records of groups of weedy seadragons, from 3 to 20 animals.

No. Weedy Seadragons per Group *(including repeat sightings)*	**Location**	**Bioregion**
20 (18 were juveniles)	Rapid Bay Jetty	SVG
16 (12 were juveniles)	Rapid Bay Jetty	SVG
12 (2 records)	Rapid Bay Jetty	SVG
12 *(old record from November 1984, in "historical" database)*	Encounter Bay	SVG
12	Noarlunga Tyre Reef	SVG
12	Blackfellows Caves area	OTW
11	Avoid Bay	EYR
11	Grange Tyre Reef	SVG
11	Rapid Bay Jetty	SVG
10 (2 records, one of which included 4 juveniles)	Rapid Bay Jetty	SVG
10	northern Kangaroo Island	SVG
9	Rapid Bay Jetty	SVG
8	Rapid Bay Jetty	SVG
8	Grange Tyre Reef	SVG
8	Noarlunga Tyre Reef	SVG
8	Encounter Bay	SVG
8 (*old record from December 1979, in "historical" database*)	Seaford	SVG
7 (4 records)	Rapid Bay Jetty	SVG
6 (3 records)	Rapid Bay Jetty	SVG
6	a bay in lower South East SA	OTW
6	2.5km east of Port MacDonnell	OTW
5 (6 records)	Rapid Bay	SVG
5	Encounter Bay	SVG
4 (5 records)	Rapid Bay	SVG
4 (3 records)	Encounter Bay	SVG
4 (2 records)	Avoid Bay	EYR
4	a bay in lower South East SA	OTW
3 (8 records)	Rapid Bay	SVG
3 (2 records)	Seacliff	SVG
3	Grange	SVG
3	Encounter Bay	SVG
3	northern Kangaroo Island	SVG
3 (2 records)	Avoid Bay	EYR

Excluding beachwash records, 48 records of pairs of weedy seadragons, mostly adults, have been reported, from Rapid Bay (15 records); Seacliff (7 records); Noarlunga Tyre Reef (5 records); reefs and islands in the Victor Harbor / Encounter Bay area (6 records); patch reefs and the tyre reef off the Glenelg area (6 records); Second Valley (2 records); Blackfellows Caves area in the south east (2 records); Grange Tyre Reef in the metro area (1 record); Gerloff's Bay in the south east (1 record), and one record each from Point Turton, Innes National Park, and Edithburgh, off lower Yorke Peninsula.

To date, about 55% of weedy seadragon sightings by underwater modes (i.e. day or night SCUBA diving, or snorkelling) have been single animals, and 13 of those sightings were of single juvenile weedies. The largest numbers of records of single adult weedy seadragons have come from popular diving sites such as Rapid Bay (26 records); sites in the Encounter Bay / Victor Harbor area (16 records); Second Valley (15 records); Seacliff (13 records); and the Glenelg area (including natural reefs, the tyre reef, and wrecks) (collectively 11 records). Records of single juvenile weedies have come from Rapid Bay (7 records); reefs in the Encounter Bay area (2 records); Grange Tyre Reef (2 records); Carrickalinga area and Second Valley on the Fleurieu Peninsula; Edithburgh on Yorke Peninsula, and Port Hughes in Spencer Gulf.

For leafies, the largest groups recorded to date in the database include an aggregation of approximately 100 leafies sighted during a night dive in Encounter Bay in June 1994, and a record from the "historical" database, of 20 adult leafies observed during a dive at an island in Encounter Bay, in January 1988. The 100 leafies observed during a night dive likely refer to a breeding aggregation - the species is known to congregate in late winter and spring to pair and mate (Kuiter, 2000, 2003). Apart from these two records, there have been only 5 other sightings to date (in the main Dragon Search database) of aggregations of 10 or more leafies, these being groups of:

- 14 adults and 2 juveniles sighted at the Rapid Bay jetty in January 2000;
- 8 adults and 5 juveniles sighted at a jetty in south-western Gulf St Vincent in August 1994;
- 12 adults sighted at a headland in Encounter Bay, in 1980 (in the "historical" record database);
- 12 adults sighted at a headland in Encounter Bay, in October 1991; and
- 6 adults and 4 juveniles sighted at Rapid Bay in December 1999.

These and other records are detailed in the table below.

No. Leafy Seadragons per Group ***(including repeat sightings)***	**Location or Marker**	**Bioregion**
100	Encounter Bay	SVG
20 (*old record, from January 1988, in the "historical database*)	Encounter Bay	SVG
16	Rapid Bay	SVG
13 (5 were juveniles)	a jetty in south-western GSV / "heel" of Yorke Peninsula area	SVG
12 (*2 records, one of which is from July 1980, in the "historical" database*)	Encounter Bay	SVG
10 (4 were juveniles)	Rapid Bay	SVG
9 (2 records)	Rapid Bay	SVG
9 (juveniles)	Encounter Bay	SVG
8	Rapid Bay	SVG
8	northern Kangaroo Island	SVG
7 (4 records)	Rapid Bay	SVG
7 (*3 records, one of which is from July 1979, in the "historical" database)*	Encounter Bay	SVG
7 (3 records)	Western GSV	SVG
6 (3 records)	Rapid Bay	SVG
6	a jetty in south-western GSV / "heel" of Yorke Peninsula area	SVG
5 (5 records, one of which included 4 juveniles)	Rapid Bay	SVG
5	Encounter Bay	SVG
4 (12 records)	Rapid Bay	SVG
4 (all juveniles)	Grange	SVG
4	a jetty in south-western GSV / "heel" of Yorke Peninsula area	SVG
4	a jetty in western GSV	SVG
4	a jetty in south-western GSV / "heel" of Yorke Peninsula area	SVG
4	Wedge Island	EYR
3 (13 records)	Rapid Bay	SVG
3 (2 records)	Second Valley	SVG
3	Encounter Bay	SVG
3	a jetty in south-western GSV / "heel" of Yorke Peninsula area	SVG
3 (3records)	a jetty in south-western GSV	SVG
3 (3 records)	Penneshaw, KI	SVG

Pairs of leafies have been observed at Rapid Bay (36 records); Penneshaw area on Kangaroo Island (20 records); Seacliff Reef (6 records); a grain jetty in western GSV (6 records); Hallett Cove; Seaford Reef (2 records); Second Valley (2 records); Rapid Head (1 record); sites in Encounter Bay (collectively, 4 records); Edithburgh (2 records), a jetty in south-western GSV, and Stansbury on the Yorke Peninsula (1 record each); an island in Thorny Passage, lower Spencer Gulf (1 record); and one record each from a cove off northern Kangaroo Island, and two sites in the lower South East of S.A.. Excluding beachcombing reports, there were 287 records of single adult leafy seadragons sighted in water, half of which came from jetties (see section **9** below, on jetty records). Of those 287 records, 24% of which came from Rapid Bay jetty, the most popular and well known diving location in SA for viewing seadragons; 13% from reefs and islands in and out of Encounter Bay; 13% from a site on north-eastern Kangaroo Island and another 10% from the Penneshaw area, where dive tours operate to view seadragons; nearly 7% from the Edithburgh area (particularly the jetty, which is also a popular dive spot); 5% from Second Valley; 4% from the Seacliff area; and nearly 3% from a grain jetty in south-western Gulf St Vincent.

Small numbers of records of single adult leafies came from Aldinga; Port Stanvac off the southern metropolitan area; natural and artificial reefs off Glenelg; a jetty in lower south-western Gulf St Vincent; an island in Thorny Passage, and another island south of Spencer Gulf; Coffin Bay and Avoid Bay on the Eyre Peninsula; and a cove on northern Kangaroo Island.

Single location records of single adult leafies were reported from:

- Kingston Park and Marino Rocks in the metropolitan area;
- West Island, out of Encounter Bay;
- Port Willunga; Rapid Head; Carrickalinga area; Cape Jervis on the Fleurieu Peninsula;
- Corny Point, Troubridge Point, Stansbury, Wool Bay and Port Vincent areas on the Yorke Peninsula;
- Cable Hut Bay, Cape Spencer area, and Stenhouse Bay in the Innes National Park area of the foot of Yorke Peninsula;
- Three islands in Thorny Passage, lower Spencer Gulf;
- Corvisart Bay (“Back Beach”), Point Westall and Smoky Bay on the west coast of SA;
- Kingscote area, Snug Cove area, and a site on north-western coast of Kangaroo Island; and
- Lacepede Bay (Kingston area), in the South East.

Single juvenile leafies have to date been recorded from 14 different areas (representing 47 records), including 10 records from Rapid Bay; 10 records from north-east Kangaroo Island; 8 records from the Encounter Bay area; 6 records from Edithburgh (mainly the jetty), 3 records from another jetty in south-western Gulf St Vincent, and 2 records from Seacliff. There is one record of a single juvenile leafy for each of the following locations: a bay on the mid-northern coast of Kangaroo Island; Port Noarlunga; Carrickalinga / Normanville area; Second Valley on the southern Fleurieu; a grain-loading area in SW Gulf St Vincent; and Point Turton and Port Victoria area in Spencer Gulf.

As with weedies, it is possible that some of the leafy seadragon records represent repeat sightings of the animal(s), or the same members of loosely structured groups. Such examples were recorded either during the same day, or, in the case of some groups, within a few days of the previous dive. For example, the following are some of the pairs or sets of dive records that appear similar (N.B. not all pairs of similar records from Rapid Bay are included, in cases where the depths were not identical, or the sightings were more than 1 day apart):

- *Rapid Bay:* a record of 4 adult leafies, and a record of 2 adult leafies and 2 juveniles, recorded at the same depth, two days apart in November 2001;
- *Rapid Bay*: A record of 3 adult leafies and 1 juvenile leafy, and a record of 2 adult and 2 juvenile leafies, recorded at the same depth, two days apart in November 2001;
- *Rapid Bay*: A record of 2 adult and 3 juvenile leafies, and a record of 2 adults and 1 juvenile, recorded at a similar depth, one week apart in October 2001, as well as two records each of 4 adults, sighted at the same depth on the previous day to one of those sightings;
- *Rapid Bay*: 2 adult leafies sighted at 10m and 2 adult leafies sighted at 7m, on the same day in November 2001;
- *Rapid Bay*: A record of 4 adult leafies, and a record of 2 adult leafies, recorded at the similar depth, on the same day in March 2001;
- *Two jetties in south-western GSV*: (i) a record of 3 adults and 1 juvenile, and a record of 2 adults, recorded at the same depth, one day apart, in June 2000, and (ii) a record of 2 adult leafies and 1 juvenile leafy, and a record of 2 adult leafies, recorded at a similar depth, on the same day in March 1997;
- *Stenhouse Bay*: Two records of 2 adult leafies, sighted on the same day, at two similar depths (5m, 7m) in the same habitat.

A number of sightings of single seadragons also refer to the same animals. For example 5 records of single leafies observed in August 2001 in western Encounter Bay, provide detail of the same animals sighted during dives the previous month at that location.

7. Brooding Male Seadragons

Figure 3 below summarises the number of sightings reported to date (N = 74), of brooding male weedies and leafies, over the entire state.

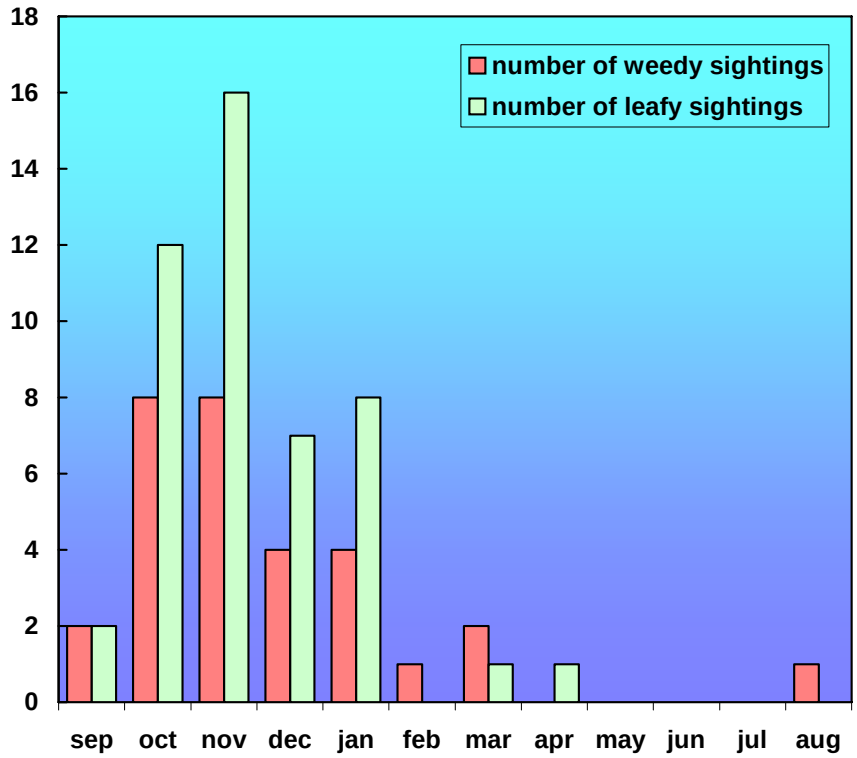


Figure 3: Monthly Summary of Brooding Male Weedy and Leafy Seadragon Sightings
(N.B. Locations and Years Combined, 1990 - 2005)

Statewide Records of Brooding Weedies: At a statewide level, with data pooled for all years between 1990 and 2005, brooding male weedies have mainly been recorded between mid-spring (October) and mid-summer (January), accounting for around 80% of the 30 records. There are also 2 records from mid-late September; 2 records from early-mid March; 1 record from February, and one anomalous record from August (see section below). The 30 records represent 35 brooding male weedies. Twenty-six of the 30 sightings of brooding male weedies to date have been single animals. There are 3 records of pairs (2 pairs of which were brooding males sighted amongst a group of seadragons), and 1 record of 3 brood males sighted together within a larger group (see section below on **Groups of Brood Males**). At a statewide scale, brooding male weedies have been recorded, to date, at depths ranging from 3m to 20m, and in waters ranging from 13^{o}C (i.e. lower South East in October) to 20^{o}C (northern Kangaroo Island in March, and Noarlunga Tyre Reef in January).

Statewide Records of Brooding Leafies: There have been 47 records of brood male leafies to date. At a statewide level, with data pooled for all years, 77 male leafies have been recorded in the 47 sightings. As with weedies, the greatest number of brood male sightings (43 of the 47) was recorded from mid-spring to mid-summer (i.e. October to January). There have been two records of brood male leafies observed in September, and one record from March, but there have been no winter recordings to date. Thirty four of the records were of single brood leafies, and there were a number of pairs also observed (7 records). Groups of brood male leafies are discussed in a separate section below. Brooding male leafies have been reported at depths ranging from 3m to 15m, and in waters ranging from 13^{o}C (a jetty off eastern Yorke Peninsula / western GSV, in April 2004) to 21^{o}C (Rapid Bay Jetty in December 1999 and January 2000).

Statewide Summary of Breeding Season for Both Species: The spring-summer breeding period for both species is supported by the fact that 37% of all diving and snorkelling records occurred during the autumn and winter months, yet very few brood males were recorded during this period, as shown in **Figure 3** above. Despite the small number of available records per year of brooding seadragons; the non-systematic nature of recording across the State; and the preponderance of diving in summer and early autumn when conditions are more conducive (amongst other factors), the data to date do support the available evidence from other southern States (as well as published information – e.g. Kuiter, 2000, 2003) that spring and summer are the *main* periods in which seadragons breed. As appears to be the case in Western Australian and Victorian waters, the egg-bearing period *may also extend past summer into early autumn*, as evidenced by several dive records from the Gulf St Vincent Bioregion: (i) 2 brood leafies and 2 brood weedies observed off northern Kangaroo Island in March 2001; (ii) 1 brood weedy observed at Rapid Bay Jetty in the first week of March 2002, and (iii) 3 brood leafies observed during April 2004 at a site off eastern Yorke Peninsula / western Gulf St Vincent.

Notes on Winter and Early Spring Breeding: To date, the only record of brood male seadragons observed in winter was a record from Encounter Bay, of two beachwash specimens recorded in August (1995). Although the specimens were freshly beached after a storm, the age of the specimens (and therefore the age of the eggs, most of which were broken) is not known. It is possible that the eggs were "hatched" earlier than the month in which the dead specimens were sighted. The date of death of the seadragons is also not known. It is therefore possible that the brood males sighted had eggs in autumn, not winter. It cannot be concluded from Dragon Search data that breeding in S.A. extends into the winter months, unless live seadragons are observed with fresh eggs during the winter period, and no such records have yet been recorded in the South Australian Dragon Search database.

Although the main breeding period appears to be between mid spring to mid summer for both species, it is possible that breeding in some areas may commence in early spring, as evidenced by the following sightings, from the Gulf St Vincent Bioregion and the Gulf St Vincent / Coorong boundary area:

- a brood male weedy at an island dive site in Encounter Bay, in late September 1993;

- a brood male weedy at Seacliff Reef, in mid-September 2000;
- a brood leafy in the Kingston Park / Marino area, in late September 1998, and
- 5 brood male leafies sighted during a dive in outer Encounter Bay, in late September 2002.

Bioregional Records: For both species combined, about 84% of records of brooding male seadragons have come from the Gulf St Vincent (SVG) bioregion. Around 76% of the records of brooding male *weedy* seadragons have come from sites in the SVG Bioregion, particularly from reefs in the Encounter Bay region between 1992 and 2000. Records from Encounter Bay account for 11 of the 23 reports of brooding male weedy seadragons in SVG Bioregion. Other areas in the SVG Bioregion in which brood weedies have been sighted include northern Kangaroo Island (2 records); Rapid Bay Jetty (4 records); Port Noarlunga Tyre Reef (3 records); Seacliff Reef (2 records) and Grange Tyre Reef (1 record). Within the Eyre Bioregion, 3 sightings of brooding male weedies have been reported, all during spring months (October and November), these being records from one of the islands in the Investigator Group in 1998; Waterloo Bay in 1998, and Avoid Bay in 1996. Within the Otway Bioregion in the South East of South Australia, 3 sightings of brood male weedies have come from a bay in the lower South East (all recorded between spring and early summer in 2002). There is also a record in the historic database of a brood male weedy reported from the Robe / Nora Creina area in January (year unrecorded). There has been 1 record to date from the Coorong (COR) Bioregion, a beachwash report from Goolwa in October 1997.

Similar to the reports of brood weedies, most records of brooding male *leafy* seadragons have come from the Gulf St Vincent Bioregion (about 89% of the records of brooding leafies, to date). Thirty of the 42 SVG Bioregion reports of brooding male leafies have come from the Rapid Bay Jetty, mainly between 1999 and 2001, although there are three older records (1991; and two from 1997), and one from 2002. To date, all Rapid Bay records of brood leafies have been recorded between October and January. Other locations within the SVG Bioregion in which brood male leafies have been recorded include western Encounter Bay (accounting for 4 reports); 2 sites on northern and north-eastern Kangaroo Island; reefs at Aldinga and Seacliff (1 record each); Kingston Park (metropolitan area), and two of the grain jetties in south-western Gulf St Vincent (3 records). Within the Eyre Bioregion (EYR), brood male leafies have been reported from islands in Thorny Passage (collectively 4 records, from 1995, 1997 and 2000). There is also a report from Wedge Island (November 1995), in the lower part of Spencer Gulf. To date, the small number of EYR Bioregion records of brood leafies were reported between November and January.

Groups and Pairs of Brood Male Weedy Seadragons: To date, there has been only one record of more than 2 brood male weedy seadragons sighted together, from an island reef in Encounter Bay, in October 1998. The report stated that 2 of the 3 brood males were swimming together, and each brood male had around 65 – 80 eggs attached. During that dive, 6 non-brooding seadragons were also observed. There have been 3 records of pairs of brood male weedy seadragons. One of these records reported the 2 brood male weedies as being part of a larger group of seadragons.

Groups of Brood Male Leafy Seadragons: For leafies, the most brood males recorded during one sighting came from a site in Encounter Bay in October 1991, when at least 6 brood males were recorded. During that dive, "wall to wall leafies, many with eggs" were observed, and 12 adult leafies in total were recorded. Two groups of 5 brood males have been reported from a seaweed habitat at another site in Encounter Bay, in late September and early October of 2002, and these 2 records may refer to the same group of animals. A group of 5 brood male leafies was also observed at Rapid Bay jetty, in January 2000, and several other adult leafies were also observed during that dive. A group of 3 brood male leafies with one non-brooding leafy was observed at one of the Gambier group of islands at the bottom of Spencer Gulf, in November 1995. A group of 3 brood male leafies was also observed at one of the grain jetties in south-western GSV, in April 2004. Pairs of brood male leafies were mostly recorded from Rapid Bay Jetty during late spring to mid summer (6 records, ranging between November 1999 and November 2001), and 1 record of a pair of brood male leafies came from a site on northern Kangaroo Island (March 2001). Single brood leafies (34 records) are discussed above (see ***Statewide Records of Brooding Leafies***).

Weedy Brood and Leafy Brood Males Sighted Together: To date, 3 records have noted both weedy and leafy brood male seadragons together. In one of these sightings, of 2 brood leafies and 2 brood weedies seen at a site on northern Kangaroo Island in March 2001, 6 non-brooding leafies and 8 non-brooding weedies were also observed. There have been 2 records from the Rapid Bay Jetty (November 2000 and November 2001) in which one brooding male of each species was observed. A female weedy was also observed in one of the Rapid Bay sightings, and 6 weedies and 3 leafies were observed during the other Rapid Bay sighting in which brood males of both species were recorded.

Maps 3A and **3B** in **Appendix 1** summarise the distribution of sightings of brood male weedy and leafy seadragons, to May 2005.

8. Juvenile Seadragons

To May 2005, juvenile weedies and juvenile leafies have apparently both been recorded throughout the year except in September (with more records of juvenile weedies during summer and autumn than at other times of the year). Including beachcombing records, 52 records of juvenile weedies have been reported (23 of which came from Rapid Bay), and 98 records of juvenile leafies. Excluding records of old specimens in the beachwash, which can add error to the distribution of months in which seadragons are of juvenile size, 46 sightings of juvenile weedy seadragons have been recorded and 96 sightings of juvenile leafies. The larger number of sightings of juvenile leafies compared with weedies reflects (i) repeated diving over two months in 2001 at one site where juvenile leafies were observed (in Encounter Bay); (ii) repeated diving during the summer of 1997-98 at a north-eastern Kangaroo Island tourist dive site where juvenile leafies were observed; and (iii) regular diving at Rapid Bay when juvenile leafies were observed, such as the summer of 1999 and the spring of 2001 (N.B. Rapid Bay records of juvenile leafies range from 1996 to 2005).

Weedies: The tables below list the locations at which groups of juvenile weedy seadragons (both with and without adults), have been observed, excluding beachwash records, which are discussed in a separate section below.

Marker	No. Weedy Juveniles	No. Weedy Adults
Rapid Bay	18	2
Rapid Bay	12	4
Rapid Bay	4 (2 records)	6; 2
Rapid Bay	3 (2 records)	1; 0
Rapid Bay	2 (2 records)	3; 3
Second Valley	2	0
Seacliff	2	0
Edithburgh	2	0

As shown in the table above, groups of juveniles were recorded mostly at Rapid Bay, including a large group of juveniles (18 animals) sighted in March 1999. Excluding beachwash records, single juvenile weedies observed alone or with one or more adults, have been recorded at

- Rapid Bay (15 records);
- reefs in the Encounter Bay area (collectively, 4 records of single juvenile weedies, and adult weedies were also recorded in two of those sightings);
- Second Valley and Carrickalinga (1 record each);
- Seacliff (2 records);
- Grange Tyre Reef (3 records);
- Port Hughes (1 record);
- Edithburgh (1 record), and
- Avoid Bay (1 record).

Beachwashed juvenile weedies have been recorded in 5 Bioregions, at sites such as:

- Troubridge Island, Henley Beach, Sellicks Beach, Haycock Point (Carrickalinga) and Hindmarsh River estuary (Victor Harbor) in the SVG Bioregion;
- Port Elliot (SVG / COR boundary area), Middleton and south of the Murray Mouth, in the COR Bioregion;
- Hardwicke Bay in the SGF Bioregion;
- Black Point (Kangaroo Island) in the EYR Bioregion; and
- Streaky Bay in the MUR Bioregion

There are 33 records of juvenile weedies for which habitat details are specified, 22 of which included seagrass as part of the habitat description. Juvenile weedies have also been observed in seaweed; on reefs (e.g. amongst rocks); on sand; in rock pools; in mixed seagrass / seaweed habitat and seagrass / reef habitats; near jetty pylons; and over artificial tyre reefs. Seadragons in these habitats were engaged in the commonly-observed activities, mostly hovering / resting, although there were several records for which swimming or feeding were specified.

Leafies: The table below summarises the locations of records of juvenile leafy seadragons. The largest number of juvenile leafies observed in one location has come from "The Bluff", and these 9 animals were recorded during a winter dive (July 2001). The Port Giles report of 5 juvenile leafies with 8 adults was also recorded during winter (August 1994). The table shows other locations where small groups of juvenile leafies have been observed.

Marker	No. Leafy Juveniles	No. Leafy Adults
Encounter Bay	9	0
Port Giles	5	8
Rapid Bay	4 (2 records)	6; 1
Grange	4	0
Rapid Bay	3	2
Rapid Bay	2 (7 records)	14; 5; 7; 2; 0; 0; 0
Encounter Bay	2	0
Wool Bay	2	5
Marion Bay	2	0
North-eastern Kangaroo Island	2 (2 records)	0; 0

Excluding beachwash records, single juvenile leafies observed alone or with one or more adults, have been recorded from dive and/or snorkel sites at:

- Rapid Bay Jetty (22 records);
- A site on north-eastern Kangaroo Island (16 records)
- Encounter Bay (6 records)
- Edithburgh Jetty (6 records)
- Two jetties in western GSV (6 and 2 records, respectively)
- Seacliff Reef (2 records)
- Second Valley (2 records)
- Screwpile Jetty, Encounter Bay (2 records)

Locations for which there is currently a single record of a juvenile leafy seadragon include: a bay on northern Kangaroo Island; an island in Encounter Bay; a reef in the Normanville / Carrickalinga area, sites at Second

Valley and Port Willunga, and Port Noarlunga Jetty in Gulf St Vincent; Port Victoria in Spencer Gulf; a site off Innes National Park, a jetty in Hardwicke Bay (south-eastern Spencer Gulf) and a grain jetty in western GSV.

No behaviour was recorded for around 28% of the juvenile leafies that have been sighted to date. For records in which behaviour was reported, *hovering* was the most commonly recorded behaviour of juvenile leafies, followed by *swimming*, and *hovering and swimming*, and there were a few records which noted *feeding*. Juvenile leafies have been recorded in seagrass habitats on sand or rubble; seaweed-dominated reefs; sand and rubble habitats with no cover specified; also in the vicinity of jetty pylons; on reefs (including artificial tyre reefs) and in rock crevices; and in a variety of mixed habitats (e.g. seaweed-covered reefs interspersed with seagrass patches).

Juvenile leafies in the beachwash have been reported from near the Kingscote Jetty (Kangaroo Island); Middleton Beach (Encounter Bay); Myponga Beach (southern Fleurieu); Somerton Park Beach (metro area); Hardwicke Bay in Spencer Gulf, and from Corvisart Bay ("Back Beach") on the west coast.

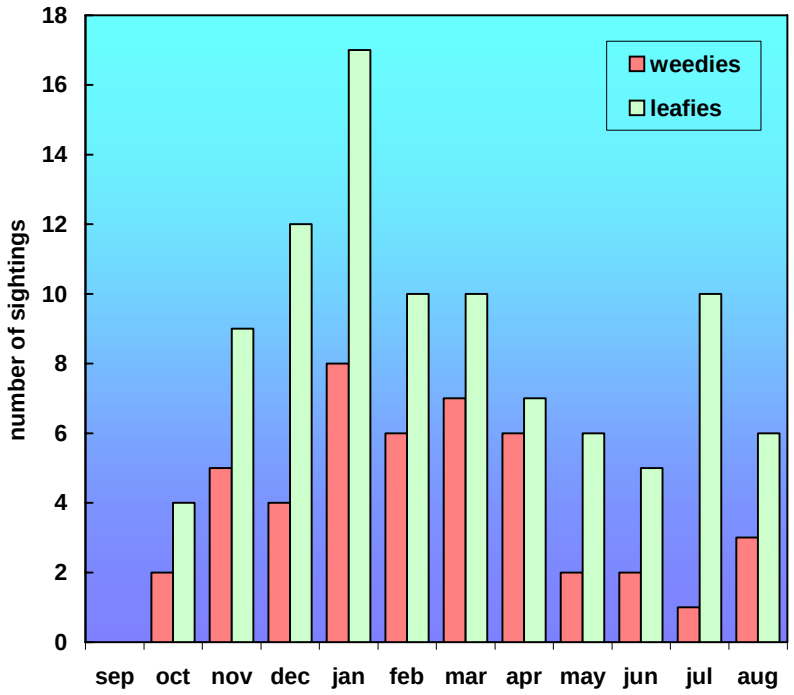


Figure 4: Monthly Summary of "Juvenile" Weedy and Leafy Seadragon Sightings

(N.B. Locations and Years Combined, and Excluding Records of Old Beachwashed Seadragons)

Records of “old” dead juvenile seadragons are not included in the graph above, because in some cases the animals may have died earlier than the month in which they were recorded, which can bias the results. Excluding those records, around 78% of juvenile weedy records were reported between the end of spring (November) through to mid autumn (April). For juvenile leafies, about 68% of the sightings were recorded during that period (November to April) (see **Figure 4** above).

For both species, it is difficult to use these data to unequivocally determine the season in which juveniles are most abundant, due to the fact that more Dragon Search dives are taken in summer and autumn (when sea conditions are more pleasant) and vice versa in winter, which can bias the results.

A size of less than 20cm is stated by the Dragon Search program as a guide to identifying juvenile seadragons. However, some of the records may be of small adults or young adults, and some might include misjudgments of size by recorders. These factors may affect the interpretation of any seasonal pattern in juvenile abundance. Additionally, the opportunistic nature of the Dragon Search sightings, and the lack of standardisation between months regarding the distribution and frequency of recordings, mean that available data cannot be used to unequivocally determine the season in which juveniles are most prevalent in South Australia.

However, it would be expected that if the main breeding period is late spring to early summer (see above, and Kuiter, 2000, 2003), then small juveniles would be prevalent from early summer to at least autumn (i.e. following the 5 week to 8 week incubation period of males). Older juveniles are likely to be observed throughout the year, because it is reported that, in captivity at least, (a) leafies take several months to grow to half of the full adult size[1], and at least one year to reach maturity (Kuiter, 2003), and (b) although weedies grow quickly, they do not reach adult size till over 12 months of age (Kuiter, 2003). This may account for the sighting of juvenile-sized seadragons throughout the year, which would be at various stages of growth following on from the summer to early autumn period in which they were hatched.

9. "Beachwash" Seadragons

Maps 4A, 4B, 4C and **4D** in **Appendix 1** summarise the distribution of sightings of beached seadragons, to May 2005. To date, a little over 200 sightings by beachcombers have been recorded, comprising a total of 830 seadragon specimens. There is also 1 beachwash record of a mass of sea urchins and sea stars washed up at Emu Bay (Kangaroo Island) after a storm, and an additional 5 records of beachwashed specimens for which a sighting mode other than *beachcombing* was recorded. About 48% of all beachcombing sightings to date were recorded during the summer months; 21% during spring; 21% during autumn, and the remainder during the winter months. About 55% of the sightings to date have been of *fresh* seadragons and 49% refer to

old specimens, and the total of these two exceeds 100% because both fresh and old seadragons were recorded in 11 sightings (5% of beachcombing records). *Fresh* dead seadragons refer to recent beachwash specimens which are not shrunken or dried, are still colourful, and usually still have the appendages intact. *Old* specimens refer to dried, shrunken and/or decomposing seadragons. Around 72% of beachwash records to date are of single specimens, although there are reports of pairs (11% of beachwash records). One sighting of a live beached seadragon has been recorded to date, of an adult weedy recorded at Tennyson Beach, in September 1995. The database also includes a small number of aggregated beachwash sightings presented as single records; for example 9 adult weedies and 1 adult leafy recorded at the Sellicks - Aldinga Beach area in 1992, over the month of January.

There are records of small groups of seadragons or single specimens being washed up on beaches, after high tides, storms and/or large swells, and around 15% of beachcombing records specified such details in the section on *other information.* Examples include the following, amongst other records specifying storms, swells and/or high tides:

- a group of 5 fresh weedies found washed up with pilchards at Sceale Bay in December 1999, during the neap tide after a storm;
- a fresh weedy washed up in December 1996 on Long Beach at Robe, after stormy period that had lasted a few days;
- 2 fresh weedies washed up at Port Willunga Beach in July 1995, following stormy weather; and 2 weedies washed up at Victor Harbor in August 1995, after a "big blow" the previous day;
- a fresh weedy washed up near the Torrens Outlet in January 1997, following a storm the previous night;
- a fresh weedy washed up to the waters edge at Pondalowie Well in November 1997, with recent storm debris on the beach;
- at least 30 weedies washed up with pilchards at Corvisart Bay in January 1999. These were old specimens but considered by the reporter to have been deposited during the previous high tide;
- 29 weedies (19 adults; 10 juveniles) found washed up with pilchards and puffer fish, at Black Point, Kangaroo Island, in December 1999, following a storm the previous day;
- 8 adult weedies and 1 leafy washed up at Vivonne Bay (KI) in December 2001, after stormy weather.
- a fresh leafy found on the high tide line at Aldinga Beach in December 2002, following rough seas for the previous 3 or 4 days before the sighting;
- a fresh juvenile leafy washed up on Somerton Beach in October 1998, after a storm; and
- recently, a fresh leafy washed up at Fishery Bay (Port Lincoln) in January 2003, after heavy weather.

There are beach records of dead seadragons (including "mass strandings"), several of which coincide with the first major recorded pilchard "die-off" event in 1995-96, and many more coinciding with the pilchard death event of late spring 1998 to late summer 1999, believed to be viral-related (Ward *et al.*, 2001).

[1] Maximum adult size of leafies is around 35 cm, according to Kuiter (1996a and 2000), or 43cm, according to Edgar (2000), although most adult leafies that have been observed by divers in S.A. are around 30cm.

Beachcombing records in the main Dragon Search database span the period 1990 to 2004, yet almost half (i.e. 45%) of all these records were reported in 1998 and 1999, and many of the records from these two years specified that the seadragons were washed up with pilchards, or that the sighting occurred during the time of the second recorded mass pilchard "die-off" in S.A. waters (during 1998 -1999). Beachwash sightings, for which dead pilchards were also recorded with the seadragons, include those in the table below, in reverse chronological order.

There were several additional records of seadragon deaths (including mass numbers) that occurred during the timing of the second major pilchard kill event (1998-99) recorded along the South Australian coastline, but those records did not specify pilchards in the beachwash. One example is 40 dead weedy seadragons found on the beach off Kent Reserve, Encounter Bay, in November 1998.

Date	Location	Beachwash Seadragons	Comment on Sighting Form
December 1999	Sceale Bay	5 adult weedies	"Specimens washed up with pilchards, unsure of exact numbers; found during neap tide after storm"
December 1999	Corvisart Bay ("Back Beach")	7 adult weedies	"Specimens washed up with pilchards; two were gravid"
December 1999	Black Point, Kangaroo Island	19 adult weedies	"Found washed up with pilchards and the odd puffer fish after stormy conditions the day before"
February 1999	South Brighton	1 adult leafy	"Found washed up in a pilchard die-off wash".
January 1999	D'Estrees Bay, Kangaroo Island	4 adult leafies	"Washed up with pilchards".
January 1999	Goolwa	2 adult weedies	"Found amongst dead pilchards (old specimens also) and puffer fish, above high tide mark, in soft dry sand"
January 1999	Corvisart Bay ("Back Beach")	31 adult weedies	"30 old, 1 fresh specimen(s) (approx. 23 male, 8 female); lots of dead pilchards with seadragons; would suggest that fish had been washed up on previous highest tide - 1/1/99 - many would have been collected by other beach combers" [i.e. prior to this sighting]
December 1998	Between Tennyson and Grange jetty	6 adult leafies	"Sightings during approx. 2 week period during pilchard kill 1998. Also notable was pink blush on bodies of seadragons as on pilchards".
December 1998	Between Grange and Henley Beach	1 adult weedy	"30cm long. A lot of dead pilchards on beach"
December 1998	Parsons Beach	12 adult weedies	"Found amongst dead pilchards at tidal rim, many 'spiky fish' where seadragons found. Seadragons found at edge of tidal rim. Informed by friend that 10 seadragons were collected on same beach over a 2 day period".
December 1998	Waitpinga Beach	1 adult weedy	"30cm long; at time of pilchard kill, found at high tide mark on sandy beach"
December 1998	Waitpinga and Parsons Beach	6 adult weedies	"Of 6 specimens, 3 were in good condition, but all old specimens in dry sand - high up on the beach - edge tide line" (Note: dead pilchards with beachwash seadragons were sited in this region previous week – see other records for area)

Date	Location	Beachwash Seadragons	Comment on Sighting Form
November 1998	Head of Great Australian Bight	7 adult weedies	"Coincided with pilchard kill". Reporter stated that "other sightings were recorded from the Point Bell location".
November 1998	Flour Cask Bay, Kangaroo Island	7 adult weedies	"Masses of pilchards, brine shrimp, 6 crabs, 2 scorpion fish, 2 globe fish, 1 baby pilot whale; were all washed up with pilchard beach-washings".
November 1998	Venus Bay	2 adult weedies	"Masses of pilchards; 3 seahorses (all fresh; one black and white striped) washed up 1 week after mass pilchard death".
October 1998	Henley Beach	1 adult weedy	"Lots of dead pilchards all the way along the beach".
July 1996	Frenchman's Beach (Coffin Bay area)	75 adult leafies	"Time of pilchard deaths".
July 1996	Fishery Bay (southern Eyre Peninsula)	2 adult leafies	"50-100 dead leafies at Frenchman's Beach at same time. Time of pilchard deaths".

Beachwashed seadragons have been recorded from more than 60 locations along the South Australian coast. The tables below show some of the main locations in each Bioregion where beachwashed specimens have been recorded.

SVG Bioregion Beachwash Sightings

About 60% of all beachwash reports to date have come from the Gulf St Vincent Bioregion. This is not surprising, given the larger population relative to other parts of South Australia (particularly the popularity of metropolitan beaches); as well as the fact that Dragon Search has been more widely promoted and recognised in the metropolitan and southern Fleurieu areas compared with other parts of the State. The 124 Gulf St Vincent Bioregion sightings collectively total 215 animals. The table below details these sightings.

Example Locations	Marker	No. Beachwash Reports	No. Beachwashed Specimens Recorded
"The Groynes" / Hindmarsh River Estuary (11) *Chiton Rocks* (5) *Between Hindmarsh River and Chiton Rocks* (3) *Near Kent Reserve* (2)	*Victor Harbor*	26	91
Henley Beach (6) *(vicinity of the jetty)* (6) *(vicinity of the Torrens outlet)* (5) *(near Marlborough St)* (3)	*Henley Beach*	23	23
Sellicks Beach (6) *Cactus Canyon* (3) *(vicinity of the boat ramp)* (3) *Between Sellicks Beach and Silver Sands* (2)	*Sellicks*	14	29

Example Locations	Marker	No. Beachwash Reports	No. Beachwashed Specimens Recorded
Haycock Point area (3) *Carrickalinga Beach* (1) *Carrickalinga Head* (1) *Carrickalinga South* (1) *Normanville Beach* (2)	*Carrickalinga / Normanville area*	8	8
North of Brighton Jetty (3) *Brighton Beach* (2) *South of Brighton Jetty / South Brighton* (3)	*Brighton / South Brighton*	8	9
(vicinity of Tennyson Beach) (4) *b/w Tennyson and Grange Jetty* (1)	*Tennyson*	5	10
Waitpinga Beach (4) *Parsons Beach* (3) *"Waitpinga and Parsons Beach"* (1)	*Parsons Beach / Waitpinga area*	8	24
Semaphore Beach (2) *Fort Glanville* (1)	*Semaphore / Semaphore Park*	3	3
West Beach	*West Beach*	3	3
Hallett Cove Beach (2) *(near Conservation Park)* (1)	*Hallett Cove*	3	3
(near kiosk) (2) *Aldinga Beach* (1)	*Aldinga*	3	3

Within the SVG Bioregion, around 21% of the beachwash sightings from that Bioregion have come from the Victor Harbor / Encounter Bay area and around 19% from the Henley Beach area. Details of these and other locations are listed in the table above.

Two beachwash sightings each have been reported from Troubridge Island (single weedies); Port Vincent (2 sightings of fresh leafy seadragon specimens in the beachwash); Somerton Beach (2 old specimens of adult weedies, and 1 fresh specimen of a juvenile leafy) and Seacliff Beach (1 weedy seadragon specimen per sighting, one old and one fresh). Single sightings within SVG Bioregion have been reported from:

- West Lakes shore in the metro area: 1 old beachwash weedy;
- Cape Cassini on Kangaroo Island: 1 old beachwash weedy;
- Kingscote on Kangaroo Island: 1 fresh juvenile leafy;
- Port Willunga Beach: 2 fresh beachwash weedies;
- Myponga Beach: 1 fresh juvenile leafy;
- Moana Beach: 1 fresh beachwash weedy;
- Waterloo Bay, near Port Moorowie, on the Yorke Peninsula: 1 old beachwash leafy;
- Foul Bay on the Yorke Peninsula: 1 fresh beachwash weedy.

Note on Northern Gulf St Vincent Sightings: Not including the ***Historical Records*** discussed in a separate section below, the most northern Gulf St Vincent sightings in the main Dragon Search database have mostly been of beachwashed, not live, seadragons, from locations such as Port Vincent (Yorke Peninsula side of the gulf); Semaphore; West Lakes shore; and Tennyson. The only live dragons observed in the northern metro beach region of Gulf St Vincent have all been from a single location – the Grange Tyre Reef, at 19m – 21m deep, from which 9 reports have come (8 of these were sightings of weedies; 1 was a sighting of 4 leafies). It would be useful to survey the habitat area seaward of the Semaphore – West Lakes – Tennyson area, to determine whether the beachwashed seadragons at these northern metro locations came from habitats adjacent to the beach areas on which they were found. The only SCUBA records from the vicinity of those locations came from Grange, in deeper water, on an artificial reef. Although there are few areas of interest to recreational divers in the northern gulf (hence the lack of records for that area), there is also the possibility that suitable habitat for seadragons is now lacking in the northern metro beach areas, particularly due to long term damage to the benthic environment (see Hart, 1996 and 1997; Cheshire *et al*. 1998, and EPA, 1998 and 2003, and section later in this report, on **Threats**). Live seadragons have been recorded from the northern Gulf St Vincent area during the late 1960s to the early 1970s, prior to the significant, cumulative extent of seagrass decline that has occurred during the last 30 years, and these records are discussed in a separate section below on ***Historical Records***.

EYR Bioregion Beachwash Sightings

To date almost 21% of all beachwash records have come from the Eyre Bioregion, representing 43 reports. Eight of the EYR Bioregion sightings have come from the vicinity of Coffin Bay or the Coffin Bay National Park, two of which were "mass" beachwashings, comprising 75 dead leafies at Frenchman's Beach in July 1996 (see below), and 30 weedies (old specimens) recorded from Sensation Beach in March 2002. Four of the 43 beachwash sightings have come from the Seal Bay (Bales Beach) area on southern Kangaroo Island, and those sightings were reported between 1995 and 1999; all were records of adult weedies, although one adult leafy was also seen in one of those sightings.

Beachwash sightings of note in the Eyre Bioregion include those that occurred following the time of the mass deaths of pilchards, in late 1995 – early 1996 and late 1998 through to 1999. One example is the Frenchman's Beach record mentioned above (i.e. 75 dead leafies washed up in July 1996). Seven weedies were also found washed up with pilchards at Flour Cask Bay (KI), in November 1998, during the period of the second pilchard mass death event.

There was a sighting of 29 old specimens of weedy seadragons on a beach at Black Point (Kangaroo Island) in December 1999, but it cannot be determined whether or not these old specimens were related to the second "mass" pilchard kill event of late 1998 – early 1999. During the same month (December 1999), there was a record from Mt Camel Beach (near Anxious Bay) of around 250 weedies and 20 leafies washed up on the beach. Apart from that Mt Camel record in late 1999, there are other reports from the Anxious Bay area, not associated with the pilchard death events, such as small numbers of seadragons found during the Ocean

Litter surveys of 1997 and 1998, and two older records (one from 1993, of approximately 12 weedies and 12 leafies washed up on Mt Camel Beach, and one record from 1990, of 6 fresh leafies washed up on that beach). The largest numbers of beachwash sightings from each area within the EYR Bioregion are summarised below. Both weedies and leafies have been recorded in the beachwash at Hanson Bay and Vivonne Bay, on southern Kangaroo Island.

Example Locations	Marker	No. Beachwash Reports	Total No. of Beachwashed Specimens Recorded
Sensation Beach; Greenly Beach; Frenchman's Beach; Shelley Beach; Gallipoli Beach; Altmona Beach	*Coffin Bay / Coffin Bay National Park*	8	115 (approx.)
Bales Beach (4)	*Seal Bay, KI*	4	7
Mt Camel Beach (3) *b/w Talia Caves & Lovers Rocks* (2)	*Anxious Bay*	4	307 (approx.)
Hanson Bay	*Hanson Bay, KI*	3	5
(vicinity of Vivonne Bay)	*Vivonne Bay, KI*	3	11

Two sightings each have been reported from:

- Whalers Way / Fishery Bay area, south of Port Lincoln (freshly beached weedies);
- Beaches around Baird Bay area (2 fresh leafies and 1 fresh weedy, from December 1995 and April 1999);
- D'Estrees Bay area on KI (a small group of leafies, and a small group of weedies, both washed up with pilchards following the pilchard death event of late 1998 – early 1999);
- Black Point on KI (a single weedy sighted on the beach in April 1999, and a group of around 29 old weedies, including 10 juveniles, washed up with pilchards and puffer fish, following a storm in December 1999).

Locations within the EYR Bioregion for which there is only one report to date, include:

- West Cape, Yorke Peninsula (1 fresh leafy, from April 1995);
- Venus Bay (2 fresh weedies, washed up with pilchards in November 1998);
- Sceale Bay, on the West Coast (5 fresh weedies, washed up with pilchards after a storm, in December 1999);
- Jones Island, near Baird Bay (1 old specimen of a leafy washed up in May 1998);

- Pondalowie Well, in Innes National Park (1 fresh weedy washed up after a storm, in November 1997);
- West Bay, western KI (1 old weedy specimen, washed high up on the sand, in April 1997);
- Cape Kersaint Beach, KI (6 fresh weedy specimens washed up in February 1999);
- Pennington Bay, KI (1 old weedy specimen washed up in September 1994); and
- Mouth Flat Beach, KI (1 fresh leafy washed up in April 1996).

There is also a mass stranding record in the "historical" database, of around 100 weedies and 100 leafies washed up at Corvisart Bay ("Back Beach"), south of Streaky Bay, in January 1987.

Of note is the number of records of "mass" strandings of seadragons in the Eyre Bioregion that did *not* coincide with the period of the two recorded mass death events of pilchards in S.A. waters, as discussed above. It is possible that in some years, summer sea conditions on the west coast (e.g. seasonal patterns in water temperature, upwellings, phytoplankton blooms and/or effect of winds on sea conditions etc) result in the death of seadragons and other fish, because beachwash masses of seadragons (sometimes with other small fish) have been recorded in the Dragon Search database from a number of areas, and in a number of years, in both the EYR and MUR Bioregions of the West Coast.

MUR Bioregion Beachwash Sightings

To date, 8 beachwash sightings have been reported from the Murat Bioregion, collectively comprising 79 specimens. Six of the 8 sightings have come from the vicinity of Back Beach (Corvisart Bay), south of Streaky Bay. One of these Back Beach records was reported in March 1995 (a fresh adult leafy seadragon specimen); 3 of the sightings occurred in January 1999, following the second mass pilchard kill in SA waters, and comprised the following:

- 2 old beachwash weedies and 1 fresh weedy, all of which were small adults;
- 5 male and 7 female weedies, and 4 male leafies (including 2 juveniles); and
- 30 old weedies and 1 fresh weedy (possibly 23 male, 8 female). Reporter stated that "lots of dead pilchards" were washed up at Corvisart Bay with the seadragons, which were likely to have been deposited on the previous highest tide - 1/1/99. It was also stated that many more dead specimens from this beachwash would have been collected by other beach combers (N.B. the other specimens were not reported to Dragon Search, so it is assumed that 31 is a minimum number from this event in the Back Beach area in January 1999).

The fifth Dragon Search record from Back Beach occurred at least 6 months after the second main recorded period of mass pilchard deaths, however that record (from December 1999) reported that the 7 fresh weedies (two of which were gravid) were washed up with dead pilchards, as did another report from the area during the same period, in which 6 fresh weedies were washed up with pilchards at Smooth Pool in December 1999.

There is an anecdotal report from April 2000 (not formally reported to Dragon Search) of a sighting of around 50 seadragons washed up on Ocean Beach near Streaky Bay. Such "mass stranding" records clearly indicate that seasonal conditions on the west coast can result in the deaths of seadragons at times other than the mass fish deaths of late 1995 – early 1996 and late 1998 – early 1999. Seasonal upwelling events and phytoplankton blooms could possibly be implicated in such cases.

The other records from the MUR Bioregion included:

- a report from the Streaky Bay area, comprising 1 juvenile weedy washed up near the Haslam Jetty in March 1999, and
- a record of 19 dried weedy seadragons found on a beach at Smoky Bay (near Ceduna) in December, 2002.

There is also an undated report of 1 old leafy seadragon specimen from Rocky Point near Ceduna.

OTW Bioregion Beachwash Sightings

To date, 7 beachwash sightings have been reported from the Otway Bioregion, collectively comprising 7 specimens (i.e. 1 per sighting). Three of the records are from the Cape Jaffa area, a Bioregion boundary zone. The Cape Jaffa area beachwash records comprise 1 old weedy seadragon (April 1998), from the beach near the Bernouilli Conservation Reserve; 1 old weedy seadragon specimen from Wright Bay (August 1998), and 1 fresh weedy seadragon specimen reported from Wright Bay in February 2000. Other beachwash records from the OTW Bioregion include 1 fresh weedy seadragon sighted at Long Beach (Robe) in September 1996; an undated record (in the "historical" records database) from Nora Creina Bay in January (1 fresh seadragon, with eggs); a sighting 2km west of Port MacDonnell in March 2000 (1 fresh weedy specimen); and 1 old weedy specimen reported in June 2001 from the beach near Nelson, just over the SA border, in Victoria. No beachwash records of dead leafies from the OTW Bioregion have yet been reported to Dragon Search.

10. Other Data (Depth of Sightings; Water Temperature)

Depth of Weedies: To May 2005, depth has been recorded for 202 of the sightings in which weedies were observed. To date, the recorded depth range of weedy sightings by divers and snorkellers collectively, is 1m to 22m. Around 75% of sightings occurring in waters between 3m and 12m; around 12% of sightings occurred between 18m and 20m deep, and few sightings were recorded at other depths within the range 1m – 22m. For weedy sightings, there have been only 2 records by snorkellers for which depth data were provided, these being sightings at 4m (Second Valley) and 9m (Rapid Bay Jetty). The most shallow records of weedies reported in the database to May 2005, have come from diving at the Second Valley Jetty (1m); dives near Blackfellows Caves in the lower South East (2m); a site in Encounter Bay (2m); and dives at two small bays in the lower South East (several records from 3m); and at Second Valley (also 3m). Records of

weedy sightings deeper than 15m have come from two reefs off Glenelg (16m, 17m); three sites in the Investigator Group in the eastern Great Australian Bight (17m, 20m, 22m); a site off Innes National Park, southern Yorke Peninsula coast (18m); a site in Avoid Bay (18m); Glenelg Tyre Reef in the metro area (records from 18m, 19m, 20m and 21m); Anxious Bay on the west coast (19m); and from the tyre reefs at Noarlunga, Glenelg, and Grange (all 20m; diver also reported sightings at 21m at Glenelg and Grange tyre reefs). The published depth range for weedies on the southern Australian coast, is between 1m and 50m (Edgar, 2000; Kuiter, 2000, 2003; Edgar, 2000).

Depth of Leafies: For leafy seadragon sightings, there are 362 records for which depth was listed by diving, snorkelling and sightings by *other* means, and to date, records in the 1990 – 2005 database have ranged from 1m to 20m. However, in the historic database, there is a record of a leafy observed on reef at 40m during a dive in the late 1960s, off Cape Cassini (Kangaroo Island). In the main database, snorkelling records during which leafies were sighted have reportedly ranged from 3m (a grain jetty in south-western GSV) to 9m (Rapid Bay Jetty). The most shallow records of leafies to date have come from diving at Rapid Bay (1m); fishing at 2m deep at Dowcer Bluff, two miles north of Port Vincent; diving in the Edithburgh Pool area (both records from 2m), a grain jetty in south-western GSV (2m), and diving out of Encounter Bay (2 records at 2m deep). Records of leafy sightings at greater than 15m have come from diving at a reef in the Normanville area (16m); Second Valley Reef (16m); a reef off Glenelg (17m), and the Grange Tyre Reef (20m). The published depth range for leafy seadragons on the southern Australian coast is between 3m and about 50m (Australian Museum, 2004b). The deepest depth records reported to Dragon Search to date have been (1) the leafy seadragon sighting recorded during S.A. Shepherd's dive at Cape Cassini at 40m depth (see ***PART 2: Historical Data***); and (ii) a verified report (based on observations made during 1985 to 1987) of leafy seadragons off the Cowell area in Spencer Gulf, being caught as bycatch during prawn trawling, in waters 30m – 40+m.

The available data cannot be used to infer the depths at which seadragons are more abundant, due to the non-systematic nature of the recordings, which are influenced by diver preferences regarding time of year, diving locations, and depth of dive. Depth recordings of seadragons are influenced by the depth of benthic habitat features of interest to divers, and the depths of dive sites where weedies and leafies are known to occur, which encourages repeat dives at those locations, and hence repeated records at particular depths. Leafies may also move seasonally, from shallow to deeper waters (Kuiter, 2000, 2003), which also influences any summary of depth recordings.

Similarly, little can be inferred about seasonal depth variations in seadragon distribution from available data. Several reasons include the fact that:

(i) the number of sightings recorded per month is opportunistic, according to diver preferences;

(ii) the survey was not standardised: i.e. seadragons were not searched for, at specific depths, in every month; and

(iii) the uneven numbers of records between months influences the depth range of the sightings that are recorded in each month (e.g. for some months, seadragons may be found at other depths that have not recorded due to the smaller number of records available for those months).

Other influences could include the fact that in some parts of the state, sighting depths are influenced by both preferred dive sites, and the depth of features at those preferred dive sites, such as depth of reef patch / "bommie"/ rock wall etc. That is, seadragons may be found at other depths in the vicinity, but such depths were not surveyed because they did not contain the feature of dive interest. It is also possible that in some cases, the depth gauge on a diver's watch might be inaccurate.

Water Temperature: Similar caveats to those specified above, apply to the interpretation of temperature recorded during seadragon sightings, particularly due to (i) the prevalence of diving from late spring to early autumn (i.e. pleasant diving conditions), especially during the summer holiday months, and (ii) the under-representation of winter sightings. To date, 41% of sightings by diving, snorkelling and other means (excluding beachcombing) were recorded in summer; almost 26% in autumn, and 20% in spring, compared with only 13% in the winter months. To May 2005, 117 weedy seadragon sightings have reported water temperature, which has purportedly ranged from 11^{o}C to 24^{o}C. Within the range, around 73% of weedy seadragon sightings for which temperature was recorded, were made in waters between 16^{o}C and 22^{o}C, with few records at cooler temperatures, due to preference for diving conditions in late spring, summer (particularly) and early autumn. To date, the highest reported water temperature in which weedy seadragons were sighted was 24^{o}C, purportedly at 17m depth, at a reef off Glenelg, in March 1999. Dives reportedly made in warm 23^{o}C waters include those at Rapid Bay Jetty (2 records from March 2001, and one from February 2005) and Grange Tyre Reef (in February 1998 and January 2001). The lowest temperature in which weedy seadragons have been sighted to date was 11^{o}C, purportedly recorded at Grange Tyre Reef (at 19m) in August 2000. Dives reportedly made in 12^{o}C waters include those at a site in Encounter Bay (June 1998), Rapid Bay Jetty (July 1999), Seacliff Reef (in July 1998, and 2 dives in July 2000), and Glenelg Tyre Reef (June 1997).

Similarly for leafy seadragons, recorded temperature for sightings to date has ranged from 12^{o}C to 24^{o}C. Dives at 12 ^{o} C in which leafies were recorded include 3 dives at Rapid Bay Jetty, in July and August 1999 and August 2000; 4 dives at two grain jetties in south-western GSV (8m – 11m), in June 2000 and July 2003; one dive at each of Encounter Bay in June 1998, Second Valley (August 1998), a reef off Glenelg (July 1997) and the Nene Valley area in the lower South East, in summer (December 1995). A single record for which a water temperature of 24^{o}C was recorded, came from a night dive in the Marino area in February 1997. Records of 23^{o}C water temperature included dives at Rapid Bay Jetty (January 1997; February 1999;

March 2000, two dives during March 2001, and two dives during February 2005); Rapid Head (February 1999); Seaford (January 1997); Aldinga (February 2001) and Grange Tyre Reef (February 1998). Around two-thirds of the 215 leafy seadragon sightings for which temperature was recorded, ranged between 16^{o}C and 22^{o}C.

11. Sites of Particular Note

Apart from the geographical limits of seadragon sightings by the Dragon Search program discussed in Section 2 (**Bioregional Distribution of Sightings**), other sightings of particular importance include the following:

***Jetties*:** There is a disproportionately high number of reports from diving at jetties (278 records, representing 18 jetties), due to repeat sightings at popular dive spots where seadragons are known to occur, such as *Rapid Bay Jetty* (from which 60% of all jetty reports have come – see section below on **Rapid Bay**, for more information); *Penneshaw Jetty* (12% of jetty reports, due to regular, repeated dives) and south-western Gulf St Vincent (another 12% of jetty reports, from two locations in that area). A number of seadragons and seadragon groups are known to be "site-associated" with such jetties and are therefore regularly recorded by divers. Despite this bias, it is clear that jetty structures in various parts of South Australia, particularly the lower Fleurieu and lower Yorke Peninsula (Gulf St Vincent side) provide important additional 3-dimensional habitat for seadragons of both species. Collectively, there have been a number of sightings from jetties in south-eastern Gulf St Vincent / Fleurieu Peninsula, western Gulf St Vincent / southern Yorke Peninsula, Encounter Bay, eastern and south-eastern Spencer Gulf, and both sides of the Eyre Peninsula. These are discussed in more detail in the internal version of this report, available from Dragon Search.

Artificial Reefs: It is notable that artificial reefs (both constructed reefs and shipwrecks) appear to be part of the habitat utilised by seadragons, and weedies in particular have been noted on tyre reefs and wrecks in various parts of the SA marine environment. For example, a total of 35 records (31 of which refer to weedies) have been reported to date, from artificial reefs such as Noarlunga Tyre Reef (11 records); Grange Tyre Reef (9 records); Glenelg Tyre Reef (10 records); the Barge and Dredge off Glenelg (2 records and 1 record respectively) and the Star of Greece Wreck at Port Willunga (1 record). Those structures in the northern area (e.g. at Glenelg and Grange) may be particularly important as additional seadragon habitat, given the pollution-induced decline in seagrass beds and macroalgae cover on patch reefs that has occurred in the area during the past few decades (see section **12**).

***Rapid Bay*:** The jetty at Rapid Bay is the most popular and well known location in South Australia where divers can observe seadragons, and the large number of Rapid Bay records in the Dragon Search database between 1990 and 2005 reflects that popularity. A number of both frequent and casual divers have recorded

seadragons at Rapid Bay over the decade, and have submitted their records to Dragon Search. Some divers have given names to the resident leafy seadragons at Rapid Bay, and weedy seadragons are also regularly recorded there. Between January 1990 and May 2005, 21% of weedy seadragon sightings, and 29% of leafy seadragon sightings came from the Rapid Bay area, including 60 records in which both leafies and weedies were sighted together. The Rapid Bay records account for ~21% of all sightings in the database, including repeat sightings of the same animals. The seadragons at the Rapid Bay Jetty have featured in international dive and wildlife publications including *BBC Wildlife*, and the location is known nationally and around the world as one of the 'spots' to dive with seadragons. Most other dive sites where seadragons are regularly seen, require boat access, but Rapid Bay can be reached from the shore, which adds to its popularity. During the past decade, the South Australian government tourism agency has been promoting the legislatively-protected leafy seadragon in its international literature, as a focus for marine tourism (Dragon Search media release, 12h June 1999) and Rapid Bay is one of the easily accessible locations where tourists who visit S.A. can see seadragons whilst diving or snorkelling. Dive instructors and dive tour companies run trips to Rapid Bay, specifically for seadragon viewing and photography, and various divers promote Rapid Bay and its seadragons on their web-sites. A *Code of Conduct* for diving near seadragons has been developed by Dragon Search (SA) and its partner organisations, in conjunction with the SA Dept for Environment & Heritage (Coast and Marine Branch) and Primary Industries & Resources SA (Marine Habitat Program). The frequent diving at some sites where seadragons are resident, particularly Rapid Bay, and the potential for disturbance of seadragons by over-enthusiastic divers prompted the development of this Code.

Encounter Bay: Between 1991 and 2005, there were around 115 sightings from the area bounded by West Island in the west, and the Murray Mouth in the east, which represents almost 14% of all records in the main Dragon Search database (i.e. not including historic records). Thirteen of these records were repeat dives at a location where one Dragon Search recorder monitored a group of leafy seadragons during the winter of 2001. However, the fact that seadragons, including groups, have been regularly recorded throughout the 1990s (and up to the present) at several locations within Encounter Bay indicates the importance of this area for populations of both species. Additionally, a research diver who monitored abalone in the West Island and Bluff areas between 1965 and the late 1990s, reported a total of around 75 sighting of leafy seadragons over that period, usually between 5m and 8m depth, at the junction of rocky reef (e.g. with *Cystophora* species and *Seirococcus*) and seagrass (*Amphibolis*) (S.A. Shepherd, pers. comm. to Dragon Search, 2002). The numerous sites within Encounter Bay at which seadragons have been regularly recorded by Dragon Search divers during the past decade, are detailed in the internal version of this report, available from Dragon Search. To preserve a confidentiality agreement, dive sites in Encounter Bay in which seadragons have been recorded, will not be presented here. In addition to dive records, between 1991 and the present there have been 43 beachcombing sightings from the Encounter Bay region (from Bluff / West I. area eastward to the Murray Mouth), detailed as follows:

- "*The Groynes" / Hindmarsh River estuary area*: 11 beachwash reports of weedies, between 1994 and 2003, including a beachwash sighting of a "mass" of 15 weedies recorded in seagrass at the high tide

mark, in February 1997; 2 reports (February and March 1999) of juvenile weedies in the beachwash, and a report of a weedy full of eggs, washed up in December 2000;

- *Kent Reserve (west of Inman River mouth):* 2 reports (1997 and 1998), one of which referred to a "mass" of 40 dead weedies, recorded in November 1998, which coincided with the timing of the second major pilchard kill event in South Australia.
- *Chiton Rocks area (between Victor Harbor and Port Elliot), and between Hindmarsh River and Chiton Rocks:* 7 records between 1995 and 2002, including notable sightings from March 1997 of 6 weedy specimens (a mix of fresh and old specimens); 2 weedies with eggs reported after a storm in August 1995, and a juvenile weedy in the beachwash, recorded March 1999.
- *Watsons Gap:* 5 records (in 4 of which weedies were sighted), all from 1999.
- *Middleton Beach:* 4 records, from 1996-1997, 2 of which were weedies and 2 of leafies.
- *Goolwa area:* 4 beachwash records, in 1997 and 1999 (1 sighting of a dead leafy; 3 sightings of dead weedies).
- *Other:* 2 records from April 1997, each of a dead weedy washed up, from "near Victor Harbor", and "Esplanade beach near end of King St"; and 1 record from February 1999, of a leafy specimen in the beachwash, 2km east of Victor Harbor.

Northern and North-Eastern Kangaroo Island: Some of the reefs around northern Kangaroo Island are known locally, nationally and internationally as tourist destinations for diving with seadragons, and regular trips to these locations occur, for seadragon viewing. There are many sightings (94 records) of leafies from reefs and the jetty in the Penneshaw area, and several sightings from other parts of north-east Kangaroo Island, from observation between 1992 and 2002. The north-eastern Kangaroo Island records, including repeat sightings, collectively account for 11% of all records. The Dragon Search records from north-eastern Kangaroo Island were provided by a KI diver, who regularly records seadragons, and their characteristics (e.g. size). Dive tours for seadragon viewing operate in the area. The seadragon records provided to Dragon Search are one example of the regularity of sightings in the area (i.e. seadragons are almost always seen on dive charter tours in the northern KI area). The regularity with which seadragons have been observed at specific locations around northern and north-eastern Kangaroo Island, over the period of a decade, indicates a strong degree of site association of the leafy seadragons in that area. The north-eastern Kangaroo Island reefs are situated in an area of steep depth gradients and high current flow, and the area is unique within the SVG Bioregion, in terms of its species composition, and biodiversity of a number of marine groups, particularly some of the attached invertebrates.

Metropolitan Records: Sightings of seadragons in the metro area are important because such records indicate the persistence of seadragon populations in modified habitats that have been subject to high levels of human-induced impacts during the last century – such as nutrient-induced seagrass loss, and nearshore reef damage due to declining water quality, including siltation of reef surfaces. To date, 118 records (around 14%) of all

Dragon Search records since 1990 have come from the metropolitan area (defined for this purpose as the coastal strip between Outer Harbor and Marino), including such areas as:

Metropolitan Location	Sighting Details
Semaphore / Semaphore Park	• 2 beachwash records, from 1995 and 1998, both being single adult leafies. • 1 beachwash record of a leafy at Fort Glanville area, January 1998
West Lakes shore	• 1 record, of a weedy observed in the beachwash, in February 1997
Tennyson	• 5 records, all beachwash sightings, from 1995, 1998 (3 records) and 2002. Four of the records were of single weedies, and 1 record referred to 6 adult leafies (observed in December 1998, on the beach between Tennyson and Grange).
Grange Tyre Reef	• Total of 9 sightings (7% of metro records), all being from the Tyre Reef (see section above on Artificial Reefs), and recorded between 1997 and 2001. • Two of the records were of weedy seadragon aggregations (11 weedies observed during a dive in June 1997, and 8 weedies observed during a dive in February 1998). • Four of the records were of single weedies (2 of which were juveniles), and there was also a record of 2 adults and 1 juvenile weedy observed in January 2001. • There was 1 record of 4 juvenile leafies observed in February 1998.
Henley Beach	• 23 sightings (19% of all metro records), all being beachwash sightings between 1995 and 2004. Most reports (17 records) were of single weedies (one of which was a juvenile). Five of the records were of leafies (recorded in the beachwash during spring and summer, between 1998 and 2000).
West Beach	• 3 sightings, all of single weedies in the beachwash (2 records from 1998, 1 from 1995). • A research diver recorded 2 weedy seadragons off West Beach during a fish survey in March 2002. The animals were seen at around 10m depth over patchy and sparse seagrass, around 500m to 1km offshore, in a direct line out from the West Beach boat ramp (B. McDonald, DEH, pers. comm., 2003).
Glenelg area	• 21 records (18% of all metro sightings), all being SCUBA sightings, mainly of weedies. Locations are listed in the internal report, available from Dragon Search.
Somerton area	• Two beachwash records, from 1997 (2 weedies) and 1998 (1 juvenile leafy), and one SCUBA record from 2003 (1 weedy, sighted offshore on Somerton Reef).
Brighton / South Brighton	• 8 records, all beachwash specimens observed between 1991 and 2002. Reports included single leafies (5 records); single weedies (2 records), and a pair of weedies (1 record).

Metropolitan Location	Sighting Details
Seacliff area	• 36 sightings (around 31% of all metro records); • 32 of the sightings came from dives at the Seacliff Reef, recorded between 1990 and 2003. These reports included pairs of leafies (5 records), single leafies (9 records), groups of 3 weedies (2 records), pairs of weedies (6 records), and single weedies (10 records). In two of those sightings, both a weedy and a leafy were recorded together; • 1 of the records came from diving at the Seacliff Wave Recorded site, in 1990 (2 adult weedies and 1 adult leafy observed); • 2 of the records were from beachcombing near the boat ramp and beach, in 1998 and 2001 (both were of single weedies);
Kingston Park	• 2 records (1 adult weedy observed in the scallop beds off Kingston Park, in the spring of 1999, and 1 adult leafy observed during a dive in the Kingston Park area, in the spring of 1998).
Marino / Marino Rocks	• 2 records, comprising the following: 1 adult leafy observed during a night dive in the Marino area in February 1997; and 1 adult weedy observed during a dive 1.5km off the Marino boat ramp, in April 1999.

The metropolitan area sightings detailed above include those from waters close to the metro beach areas of high human usage, and numerous pollution sources. The importance of such developed areas for seadragon populations should be considered in the management and mitigation of urban pollution sources (see section on **Threats**), and in local coastal marine development plans. Records of leafies and weedies from the patch reefs off Glenelg are of particular interest, because reefs off the Glenelg area are considered to be in poor condition, likely due to the long term cumulative impacts of sewage pollution and sedimentation, which may have reduced the level of cover of large brown macroalgae (Cheshire *et al*., 1998; EPA, 2003), which is an important habitat for seadragons. Another record of particular interest is the report from 1990 of a leafy at "The Blocks", a concrete breakwater nearshore to Glenelg. Despite sedimentation and sewage pollution in the Glenelg area, "The Blocks" has a population of *Ecklonia* kelp. Cheshire *et al.* (1998) considered that because the *Ecklonia* on the Blocks is growing vertically rather than horizontally, it may be less affected by the sedimentation that has reportedly contributed (along with sewage effluent) to the reduction of large brown macroalgae at other reefs in the Glenelg area. In the Dragon Search database to May 2005, only 1 record of a leafy seadragon has been reported from "The Blocks", and it is not known whether this was a resident seadragon or a visitor from the surrounding area (which is also degraded). In either case, it is likely that the *Ecklonia* would provide some support for any seadragons in the area. It may be useful to do a complete survey of the Blocks over all seasons, surveying both the seaward and leeward sides, to determine whether seadragons still exist in this nearshore area.

12. Seahorse and Pipefish Sightings

Seahorses: Seahorses were reported in 31 of the sightings, including several beachwash records. The seahorse records comprise the following:

- More than a third (13 records) of the seahorse sightings have been reported from Edithburgh between 1994 and 2005, and both Short-headed (= Short-snouted) Seahorse *Hippocampus breviceps* and Southern Pot-bellied Seahorse *H. bleekeri* have been recorded at that location, including several sightings of juveniles.
- 3 sightings from a site in Encounter Bay, 2 of which specified *H. bleekeri* (recorded in July 2000);
- 2 records from a jetty in south-western GSV, in 1996 (both records mention that seahorses have been sighted in the area on a number of occasions during dives that year); and 5 records from another south-western GSV jetty (including one record from of 4 male *H. breviceps*).

Single location sightings of seahorses have come from:

- Venus Bay (beachwash record of several freshly dead seahorses at a beach near the Conservation Park, washed up with pilchards in November 1998. One was described as "black and white striped" – this is likely to have been *H. bleekeri*, which can assume various colours and patterns, including dark and light striping, particularly on the dorsal side and tail);
- Corvisart Bay ("Back Beach" - record of "many" seahorses washed up with pilchards, in March 1995);
- A mid-western Spencer Gulf jetty (2 short-headed seahorses *H. breviceps* sighted in *Caulerpa* plants, during dives on two successive days in June 2002);
- A south-western GSV jetty (record of 5 seahorses, 75mm long, sighted in August 1994);
- Sellicks Beach (note from a beachcomber in 1998 stating that seahorses are often washed up on Sellicks Beach, mostly near Sellicks Reef to Cactus Canyon); and
- Carrickalinga Beach (snorkelling record from January 2003, or several juvenile seahorses (2cm - 3cm long) clinging to seagrass in the water column, near the surface.

Pipefish*:* There have been 43 sightings of pipefish to date, 29 of which have been reported from the Rapid Bay jetty, between 1995 and 2004. Pipefish species such as the Spotted *Stigmatopora argus* are known from the seagrass beds at Rapid Bay, and other pipefish species are also known in the area. Two of the Dragon Search reports (from 1995 and 2004) stated that "various pipefish species" were observed at Rapid Bay. Note that there is a pipefish species of limited distribution, similar to *Stigmatopora argus*. The species was previously called *Stigmatopora olivacea* (Kuiter, 2000) but was later formally described as *Stigmatopora narinosa*, the Gulf Pipefish (Browne and Smith, 2007), and is reported to be restricted to seagrass beds in the South Australian gulfs (Kuiter, 2000, 2003; Browne and Smith, 2007). Divers have recorded pipefish in the Rapid Bay area in both seagrass beds and macroalgae. One report from April 1996 described a large mass of pipefish (more than 500 individuals) feeding above seagrass beds, and other records from Rapid Bay have also mentioned "lots of pipefish", but the species identity of the large groups has not been ascertained.

Of interest is a sighting from Rapid Bay during August 1998, purportedly of a Tiger Pipefish (*Filicampus tigris*), and in 2003 the reporter of the record stated to Dragon Search that the species matched the description for *F. tigris* in fish identification texts. If this is correct, then the record is of particular interest, because Tiger Pipefish is mainly a sub-tropical species, more commonly known from Moreton Bay in Queensland; New South Wales (including Sydney Harbour), and Shark Bay, Port Hedland and Broome in WA (Kuiter 1996a, 1996b, 2000), with relatively few reports from the Gulfs region of South Australia, or anywhere else in southern Australia. In South Australia, Tiger Pipefish has been recorded mostly from Spencer Gulf, with records including the Port Lincoln area in lower Spencer Gulf (Dawson, in Gomon et al., 1994); the Shoalwater Point area in mid Spencer Gulf (South Australian Museum records 1982); and various sites in upper Spencer Gulf (Kuiter, 1996b), including more recent records from west of the Fisherman Bay / Port Broughton area (P. Jennings, SARDI, unpublished survey data, 2003).

A number of pipefish species which occur in Gulf St Vincent in seagrass beds (and other habitat) look similar to the Tiger Pipefish *F. tigris*, with examples including Pugnose pipefish *Pugnaso curtirostris*, and some of the *Vanacampus* species – see Kuiter 2003). Recent inshore demersal fish surveys and associated collections (Browne, 2004, K. Smith, pers. comm., 2004; Smith, 2005) have documented a number of pipefish species, including possible new taxa, in various locations across South Australia. A targeted survey of pipefish species in the gulfs of South Australia would be helpful to elucidate the current range of *Filicampus tigris*, as well as several species of *Vanacampus*, including less commonly observed species of limited range (e.g. *V. poecilolaemus* and *V. vercoi*).

Apart from Rapid Bay, Dragon Search reporters have recorded pipefish at:

- *Several jetties in south-western GSV*: (i) a report of 1 *S. argus* and 1 male Brushtail Pipefish (*Leptoichthys fistularius*) with eggs attached, sighted in January 2002; and a record of unidentified pipefish, from July 2003; (ii) 4 pipefish observed in August 1994; (iii) pipefish observed in June 2000;
- *Encounter Bay*: some pipefish observed in *Ecklonia* kelp, during a dive in October 2000, and others observed during a jetty dive at night in April 1998;
- *Second Valley*: 3 records, from March 2002; August 1998 and June 1996. The record from 2002 stated that the spotted pipefish (possibly *Stigmatopora argus*) was large, around 27cm, and recorded in 2m depth, in mixed seagrass (*Posidonia* and *Amphibolis*) and macroalgae habitat (*Scaberia*, and various fucoids);
- *Sellicks Beach*: note from a beachcomber in 1998 stating that pipefish are often washed up on Sellicks Beach, mostly near Sellicks Reef to Cactus Canyon;
- *Edithburgh Jetty*: 2 sightings from April 2004, both reported to be the Gulf Pipefish (see above);
- *Aldinga "Drop-Off":* 1 'brown pipefish' observed in February 2001;
- North side of *Port Noarlunga Jetty* (old record, from February 1978 – see **Part 2** below); and
- *Fishery Bay* near Port Elliot (1 dead pipefish recorded in the beachwash, in March 1997).

There is also a report of an unspecified number of a brown pipefish species, caught in the bycatch of prawn trawlers operating 5-10 miles offshore from Corny Point, in waters deeper than 30m (bycatch observations from 1985 to 1987).

13. Other Notable Species

Some of the other fish species observed and recorded during Dragon Search in S.A. include the following:

Species	No. Records (to May 2005)	Sighting Details
Western Blue Groper *Achoerodus gouldii*	**9**	• Second valley (March, 2004); • Rapid Bay Jetty (October & November 2002; January 2004); • Rapid Head (February 1999); • Northern Kangaroo Island (November 2000); • Between two Thorny Passage islands in south-western Spencer Gulf (juvenile gropers, observed in December 1997); • A site near Flinders I. (groper observed in April 1997) and • Wedge Island (March 2002).
Southern Blue Devil / Western Blue Devil (*Paraplesiops meleagris*)	**22**	Records observed between 1996 and 2004, from: • Seacliff Reef (10 records, including one from April 1996 in which Blue Devils were described as "abundant" during the sighting; and one record from October 2003 in which 8 - 12 specimens were observed during the dive); • Reefs at Second Valley (5 records, three of which specified that more than one Blue Devil was observed); • Patch reefs off Glenelg (4 records); • Seaford, southern metro area (1 record, with more than one Blue Devil observed during the sighting); • a site east-north-east of Penneshaw on Kangaroo Island (Blue Devil caught during fishing in January 1997), and • a dive site off Innes National Park (sighting from January 1998).
Cowfish = Ornate Cowfish Aracana ornata and/or Shaw's Cowfish A. aurita	**27**	• Rapid Bay: 9 records between 1996 and 2005, including 2 records in which the species (Ornate Cowfish) was specified; • Two jetties in south-western GSV: (I) 6 records between May 1996 and May 2001, one of which specified "southern cowfish" as the species; (ii): 3 records, from June 2000, May and July 2001, one of which specified the species = Ornate Cowfish; • Glenelg area: one record each from 3 different reefs, recorded in December 1995, January 1996, and August 2002; one of these specified a male Shaw's Cowfish; • Grange Tyre Reef (Shaw's Cowfish, observed December 1998); • Edithburgh jetty: 3 records, from March 1996; June 1998 (Shaw's Cowfish) and June 2000 ("lots of cowfish"); • Southern Hardwicke Bay: " a few Shaw's cowfish" observed October 1998; and • Henley Beach: one record of a female cowfish in the beachwash, February 1999.

Species	No. Records (to May 2005)	Sighting Details
Various wrasse species e.g.: • Blue-Throated wrasse *Notolabrus tetricus* • Black-Spotted wrasse *Austrolabrus maculatus* • Brown-spotted wrasse *Notolabrus parilus* • Senator Wrasse *Pictilabrus laticlavius* • Western foxfish *Bodianus frenchii*, and other wrasse species	**30**	• A small bay in the lower South-East (4 dive records between October and December 2002), during which were sighted Blue-throated Wrasse and other wrasse species, described in one of the records as "multiple species of wrasse"; • A site south-west of Blackfellows Caves (South-East of S.A.): unspecified number and species of wrasse observed in January 2003; • Second Valley: 4 records, including an unspecified number and species of wrasse observed in November 2000; various wrasse species observed on two occasions in March 2004; Senator Wrasse *Pictilabrus laticlavius* observed at Lassiter's Reef in May 2000; and • Rapid Bay Jetty: unspecified species of wrasse sighted in December 1998, October 2001, March 2003 and February 2004; • Seacliff: 4 records (from January 2002, July 2000, March 1998, and May 1996) for which the wrasse species were unspecified; • Seaford: unspecified number of various wrasse species (including *A. maculatus*, *N. tetricus* and *N. parilus*, observed in January 1997); • Glenelg: black-spotted wrasse *Austrolabrus maculatus* sighted at Glenelg Tyre Reef in May 2000, and at a patch reef in March 1999; • Two sites on northern KI: Western Foxfish recorded in November 1998; unspecified number and species of wrasse observed in November 2000; • East north-east of Penneshaw (KI): Blue-throated Wrasse caught during a fishing trip, in April 1997; • Edithburgh Jetty: wrasse (no details provided) recorded in May 2002; and Brown-spotted *N. parilus*, recorded April 2004; • Between two Thorny Passage islands in south-western Spencer Gulf: unspecified number of Blue-Throated wrasse observed in December 1997; and • Frenchman's Bluff (Coffin Bay): unspecified number and species of wrasse observed in October 1999.
Dusky Morwong *Dactylophora nigricans*	**19**	• Grange Tyre Reef: October 1997; • Three reefs off Glenelg: January 1996, March 1999 and May 2001; • Seacliff Reef: recorded during dives in October 1994; May 1996; June 1997; September and December 2000; • Seaford: January 1997; • Rapid Bay jetty: November 1995 and February 2000; • Second Valley: August 1998 and March 2004; • Jetty in south-western GSV: May 1997 and December 2001; • Small bay in lower South East SA: October 2002.
Black-banded Seaperch *Hypoplectrodes nigrorubrum*	**4**	• Three reefs off Glenelg: 3 records, from January 1996, March 1999 and October 1999; • Second Valley: report from Lassiter's Reef in May 2000

Species	No. Records (to May 2005)	Sighting Details
Gurnard Perch *Neosebastes* spp. (e.g. *N. pandus*, *N. nigropunctatus*, *N. bougainvilli*)	**2** or **3**	• Seaford: January 1997 • Seacliff: December 2000 *Note: there was also a record of "Gurnard" from Grange Tyre Reef September 1998, but "perch" was not included in the description, so this may refer to either a* Neosebastes *species, or one of the true gurnards (family Triglidae)*
Anglerfish - a number of species occur in S.A., one of the commonly sighted being Tasselled Anglerfish *Rhycherus filamentosus*	**3**	• Rapid Bay: 2 records, from November 1999 and April 2001, one of which specified the species as Tasselled Anglerfish; • Edithburgh: a number of anglers of unspecified species recorded in June 1998 • Jetty in western GSV: 1 record of an unspecified species of angler, April 2004.

Other notable records of species observed by Dragon Search records include:

- Luderick / Blackfish *Girella tricuspidata*, a south-eastern species for which SA is at the end of the range, sighted at a small bay in the lower South-East, in October 2002;
- Rock Ling *Genypterus tigerinus*: sighted at Rapid Bay jetty, in April 2001.
- Tubemouth *Siphonognathus argyrophanes*: a long slender Odacid fish related to weed whiting (observed at Rapid Bay jetty, in May 1996).
- Seamoth (*Pegasus lancifer*): a report of seamoths being caught in the bycatch of prawn trawlers operating 5-10 miles offshore from Corny Point, in waters deeper than 30m (bycatch observations were from 1985 to 1987);
- Catfish (Cobbler) *Cnidoglanis macrocephalus*: Recorded at Rapid Bay Jetty in November 2001 and May 2002, and at Marino Rocks in February 1997.
- Species of Clingfish (Gobiesocidae): There are two records: (i) Tasmanian Clingfish *Aspasmogaster tasmaniensis* (recorded at Edithburgh jetty in June 1998), and (ii) unidentified clingfish species (sighted at Rapid Bay jetty in March 2003).
- Eagle Ray *Myliobatis australis*: Records include one "8ft" eagle ray sighted at Searcy Bay in March 1999; an unspecified number sighted at Stokes Bay, Kangaroo Island, in November 2000; and an unspecified number of eagle rays sighted at Flinders Island "Hotspot" in April 1997;
- Other ray / stingray species (unspecified): including 5 records from Rapid Bay (one of which specified 3 small rays); 2 records from Seacliff Reef; 1 record from Second Valley; 1 record from the Port Elliot area (dead specimen, in the beachwash); 1 record from Wright Island in Encounter Bay (of a "huge stingray"); 2 records from Grange Tyre Reef; 1 record from Wool Bay, and 1 older record in the "historical" database, of 5 stingrays observed at Port Noarlunga Jetty during a night dive in February 1987.
- Port Jackson Shark *Heterodontus portusjacksoni*: in the vicinity of 2 jetties in south-western GSV (unspecified number of sharks sighted in December 2001; and 2 sharks, sighted in May 2002);

- Varied Catshark *Parascyllium variolatum*: 1 record from a bay on northern Kangaroo I., November 2000;
- Stingarees: 2 records, from Rapid Bay jetty in December 1998, and off Normanville, in January 1999;
- A "baby Pilot Whale" washed up at D'Estrees Bay (Kangaroo Island) in November 1998;
- 2 "scorpion fish" (family Scorpaenidae – which contain the gurnard perches, scorpion cods and fortescues) washed up at D'Estrees Bay (Kangaroo Island) in November 1998; and
- "Large numbers" of both *sea stars* (2 species) and *sea urchins*, washed up at Emu Bay (Kangaroo Island) after a storm in April 1996.
- Eleven-Armed Sea Star *Coscinasterias muricata*, and biscuit stars (*Tosia* sp.): at Edithburgh Jetty in 1996.
- Basket Stars: 2 records from Stenhouse Bay (both from March, 2005).

14. Perceived Threats to Seadragon Populations

Dragon Search Details of Threats: To date, in the Dragon Search database, there has been little specific and usable information about other activities and threats in the areas where seadragons have been sighted. In the main Dragon Search database, 42% of the records (mainly from diving), specified other activities occurring in the area in which the seadragons were sighted. Around 78% of these records reported fishing and/or boating in the vicinity of the seadragon sightings. Fifteen of the 347 records in which other activities were specified, mentioned "pollution", and 11 of these records were from Rapid Bay jetty.

Only 45 of the 828 records in which seadragons were sighted (to May, 2005), specified perceived threats to seadragons in the location of the sighting, and 60% of those records reported "pollution" as a main threat. It is noted that some Dragon Search divers listed "pollution" in the "Other Activities" section rather than the "Threats" section, resulting in 42 records in which "pollution" was specified in one of those two fields. Most of these records provided no further detail (particularly the records from Rapid Bay), however a small number of records stated the types of pollution observed, detailed as follows:

- *Rubbish:* recorded during dives off Hallett Cove Conservation Park, Seaford Reef, Seacliff Reef, Encounter Bay, and Edithburgh Jetty. The record from Edithburgh jetty in 1996 reported that bricks, tyres, beer bottles, and cockle shell bait were observed in the area. The Hallett Cove record mentioned rubbish in the seagrass, and litter is also regularly observed at the Rapid Bay jetty;
- *Siltation:* recorded at Seaford Reef, and at a patch reef off Glenelg; both reports from 1997 – see discussion below on sedimentation / siltation.
- *Sewage runoff:* Edithburgh Pool area (reportedly runoff from the local toilets, according to the Dragon Search diver);

- *Fishing debris:* reported in several beachwash records, from Kangaroo Island (Bales Beach 1996; Black Point 1999), and Wright Bay near Cape Jaffa (1998). Examples of washed up debris included plastic bait pots, rope, nets, plastic, and light globes. Fishing debris recorded during diving included fishing line under Rapid Bay Jetty (in which 1 leafy seadragon was caught, and cut free); a squid jag (next to a leafy seadragon) at one of the grain jetties in south-western GSV, and cans at Second Valley;
- *(Previously proposed) tuna pens:* a 1997 record specified that tuna pens, proposed at the time to be situated less than 1km from Taylor Island, would be a threat to seadragons at north-east Taylor Island.

Locations at which unspecified "pollution" was reported either in the "Threats" or "Other Activity" section of the sighting forms included:

- *Tyringa Beach (on the West Coast of SA)*
- *Tumby Bay Jetty (Spencer Gulf);*
- *Henley Beach Jetty and Brighton, both in the metropolitan area;*
- *Port Noarlunga*;
- *Carrickalinga Reef*;
- *Rapid Bay* (20 records, from 1999 to 2002); and
- *Nelson area (South Australian / Victorian border)*

Habitat Damage: Although not obvious from the Dragon Search reports of threatening processes, perhaps one of the biggest concerns for seadragons in South Australia is decline in habitat quality. According to the Threatened Species Network (TSN), there is "*increasing concern about the future of seadragons, which are threatened by both habitat destruction and collection for the aquarium fish trade. The Leafy Seadragon relies on seagrass meadows and algal beds which are under threat off the coast of South Australia. The Leafy Seadragon's habitat is largely disappearing as a result of decreased water quality, primarily due to land-based pollution and sediment runoff. The direct impacts of some fishing operations are also a potential threat*" (TSN, media statement for Threatened Species Day, 1999).

Pollution of nearshore habitats is considered a threat to seadragons populations, due to their strong site-association with macroalgae and seagrasses. Nearshore impacts are especially prevalent in highly urbanised areas such as Gulf St Vincent, where habitat degradation has resulted from a combination of nutrients (principally from sewage effluent discharge), multiple contaminants from stormwater and other runoff, and sedimentation effects (from sand dredging; sewage and stormwater runoff; land reclamation and coastal erosion, and other sources). The Environment Protection Authority (2003) provided a list of the various impacts from point source and diffuse sources, in various parts of the eastern Gulf St Vincent area. The impacts of these land-based pollutants on seagrasses are well documented (e.g. Shepherd, 1970; Shepherd *et al*,. 1989; EPA 1998), as is the fact that such impacts have occurred in Gulf St Vincent, causing a loss of several thousand hectares of seagrass (Hart, 1996 and 1997, EPA, 1998 and 2003). Furthermore, studies undertaken on metropolitan and southern Fleurieu reefs since the mid 1990s (see Cheshire *et al*., 1998,

Cheshire and Westphalen, 2000, Turner and Cheshire, 2002, all summarised in EPA, 2003) have shown that decline in cover of large macroalgae at some reefs in Gulf St Vincent, is, like seagrass decline, an indicator of pollution. The authors of the reef studies above consider that the presence of large, brown, canopy-forming macroalgae is an indicator of reef health, and those studies have shown that, in the northern region (e.g. Glenelg area), reefs are generally in poor condition, with little cover of large brown macroalgae, and a dominance of "turfing" brown and red algal species. On central reefs such as Noarlunga, increased coverage of mussels in sites that were previously dominated by macroalgae is also considered to indicate a decline in reef health (Smith, 2000, cited by EPA, 2003). Declines in seagrass and macroalgae cover, particularly on the eastern side of Gulf St Vincent, may have a negative impact upon populations of seadragons, by reducing available habitat in which life processes can be carried out. This concern has been the focus of a community program in the southern Fleurieu during recent years, which aimed to highlight the need to reduce runoff from coastal areas, due to its potential impact on seadragon habitat in the nearshore area.

Fishing Impacts: As shown above in the section on **Summary of Sighting Modes**, few seadragons caught as a bycatch of fishing activity have been reported to Dragon Search. Noteworthy is a report from 1985-87, of seadragons being caught during prawn trawling in the Cowell area on the mid western side of Spencer Gulf. The reporter stated that leafies (usually 1 or 2, but sometimes up to 15 animals) were observed in the trawl bycatch, from waters deeper than 30m, approximately 10 miles offshore from Cowell, in a habitat of reef ledges, with various sponges and seagrass in the vicinity. The total number of seadragons caught annually as bycatch by fishing methods in various regions in S.A., is not known. It is noted that the extent to which Weedy and Leafy Seadragons are captured in the Spencer Gulf Prawn trawl fishery is now being investigated, through a fishery independent monitoring program to document bycatch, based on research trawl surveys (PIRSA, 2003). Part of the trawl sampling is designed to assess (if possible) spatial and temporal changes in the numbers of syngnathid fish. A field manual for identification has been developed, and digital images of specimens collected from field studies have been taken. The Leafy Seadragon has been identified as an indicator species for the fishery, given its protection status in State Legislation, as well as being a listed marine species under the Commonwealth's *EPBC Act 1999*. The presence of *Phycodurus eques* will be used as an indicator of "how well the fishery implements conservation measures" (PIRSA, 2003). Independent trawl surveys to map syngnathid species distribution patterns have been initiated in Spencer Gulf. Furthermore, fishers are reportedly engaged in voluntary monitoring of Leafy Seadragon bycatch using logbooks. It is reported that, because syngnathid species populations are small on the trawl grounds, fecundity is low, and population dispersal is restricted, they are a suitable indicator for fishery risk assessment (PIRSA, 2003). It is noted however, that bycatch counts to date are reported to be very low, hence it may not be possible to detect significant inter-annual differences, unless a substantial decline in numbers is recorded (PIRSA, 2003).

Aquarium Trade: The take of seadragons for the aquarium trade is regulated by PIRSA, and a number of permits have been issued during the past decade. In the captive breeding operation, a small number of specimens with eggs are taken from the wild, and those specimens are bred in an aquaculture facility, and the progeny are exported to overseas buyers. None of the wild-caught brood stock is sold (South Australian Seahorse Marine Services, 2004). During 2004, the facility made application to harvest from the wild *Phyllopteryx taeniolatus* and *Phycodurus eques*, as well as a number of seahorse and pipefish species, for broodstock enhancement, in order to culture the species (to 4th generation only) and export the progeny (South Australian Seahorse Marine Services, 2004; Australian Government Department of DEH, 2005). The extent of the illegal trade in seadragons from South Australia is not known. To date, only one record in the Dragon Search database has provided details of likely poaching activity, from southern Yorke Peninsula, in 1995. Possible poaching (from northern Kangaroo Island) was also reported to government in 1997.

15. Acknowledgments

Particular thanks go to the divers and beachcombers who have contributed to the Dragon Search database over the past decade. The Dragon Search program is especially grateful to those divers who have regularly monitored seadragons in particular locations, and have submitted their records. Thanks also to Tony Flaherty (Marine and Coastal Community Network), Vicki-Jo Russell (Threatened Species Network) and the Marine Life Society of South Australia (MLSSA), for ongoing support of this program since its inception. The Dragon Search program also thanks the various organisations, government programs and companies listed on page 1, which have supported and/or promoted Dragon Search in South Australia.

Jeremy Gramp (Dragon Search Project Officer), Tony Flaherty (MCCN), and Vicki-Jo Russell (TSN), have all worked for a number of years to promote and develop the Dragon Search program throughout South Australia, and to assist the co-ordination of Dragon Search programs in other southern States. Jeremy also entered most of the data in the SA Dragon Search database, maintained the database, checked sighting details and contacted Dragon Search divers and beachcombers for additional information where required. The quality of this report has thus been greatly assisted by Jeremy's efforts.

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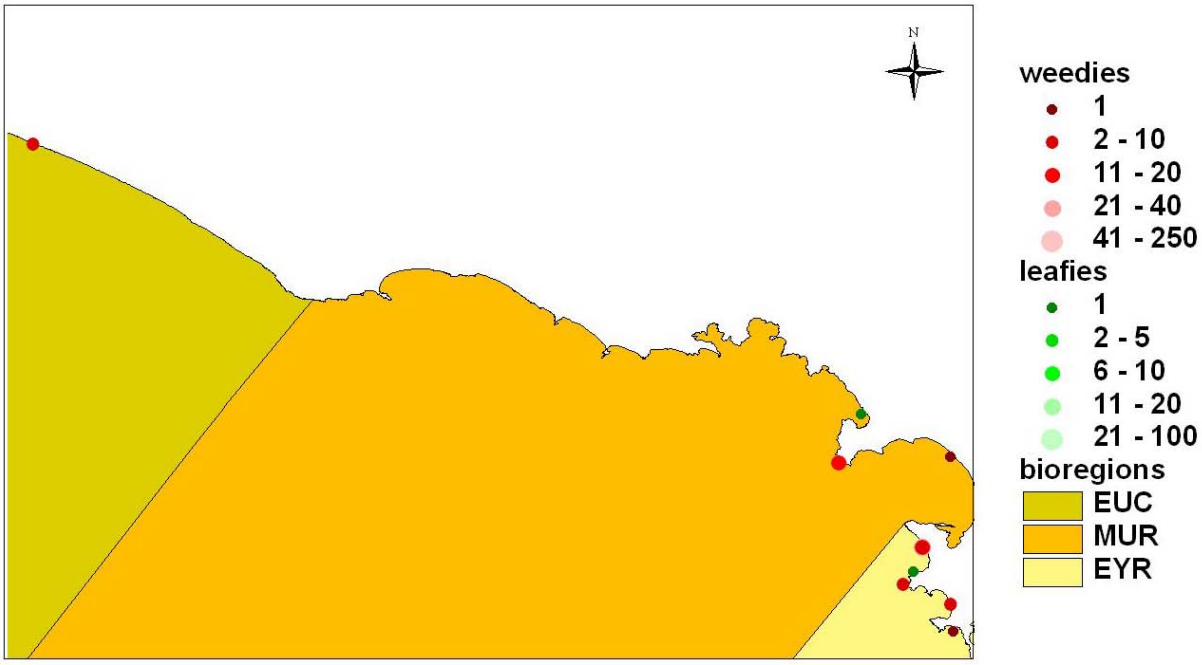
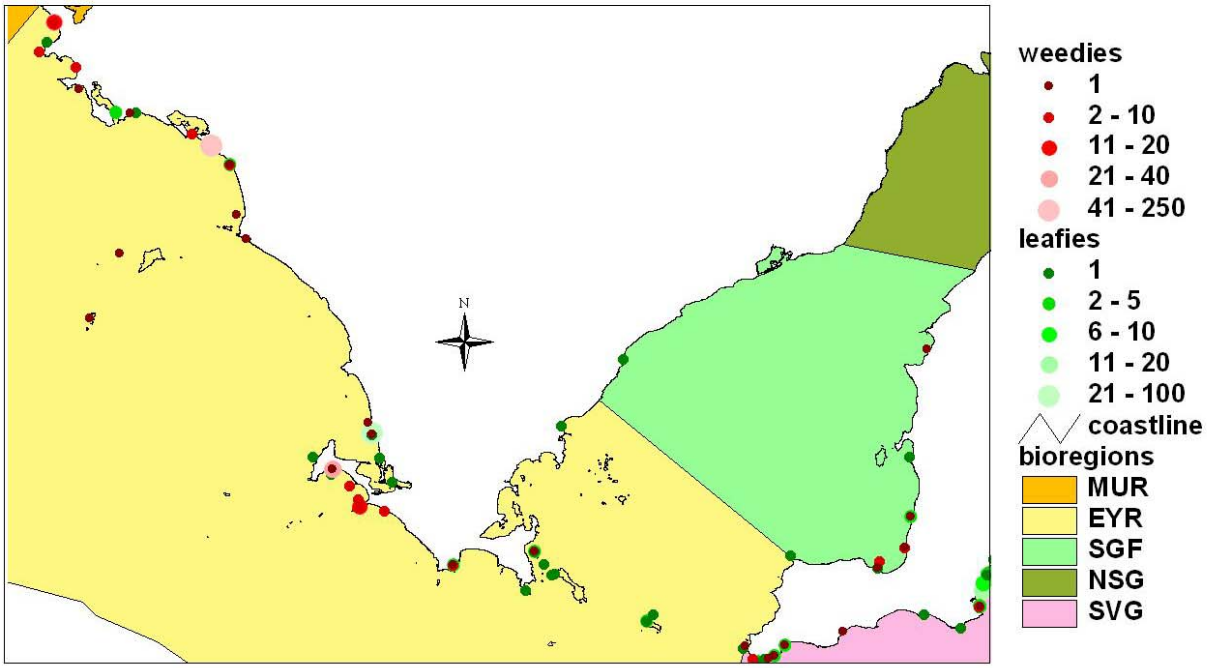
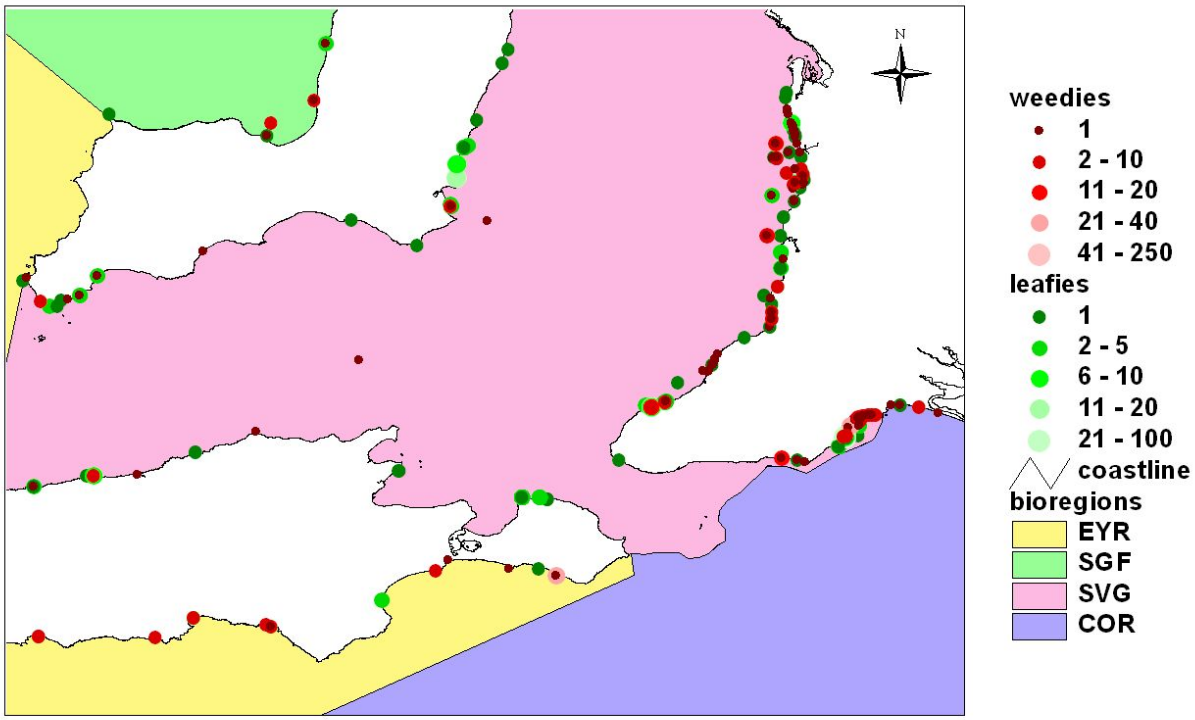
Appendix 1: Maps



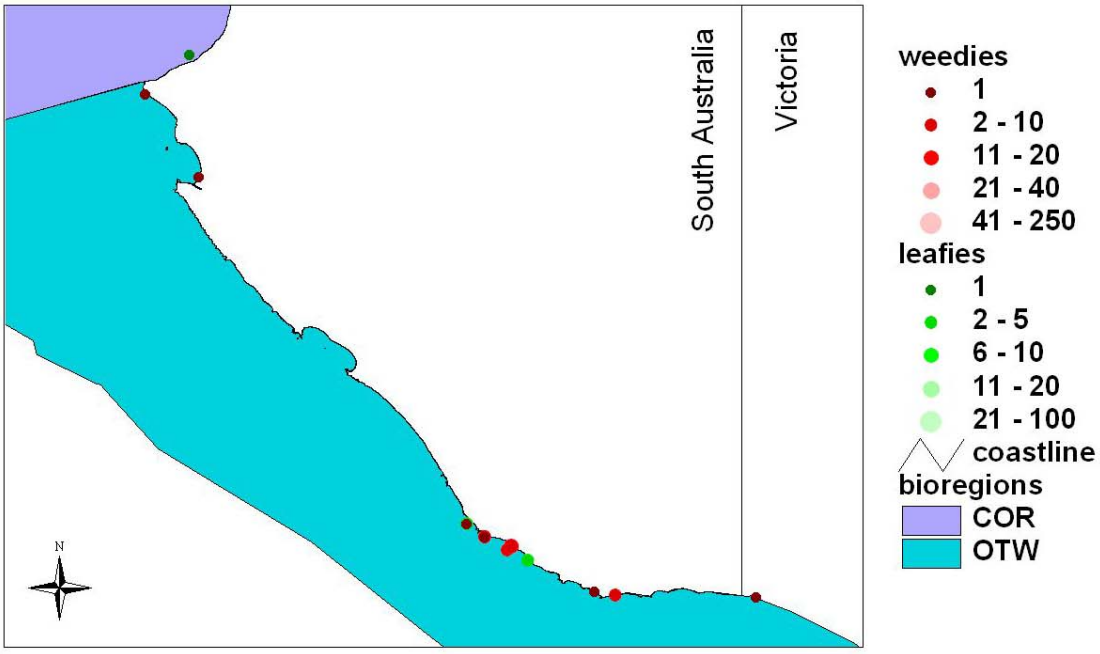
Map 2a: Number of seadragons per sighting, Eucla (EUC) and Murat (MUR) Bioregions, to May 2005.



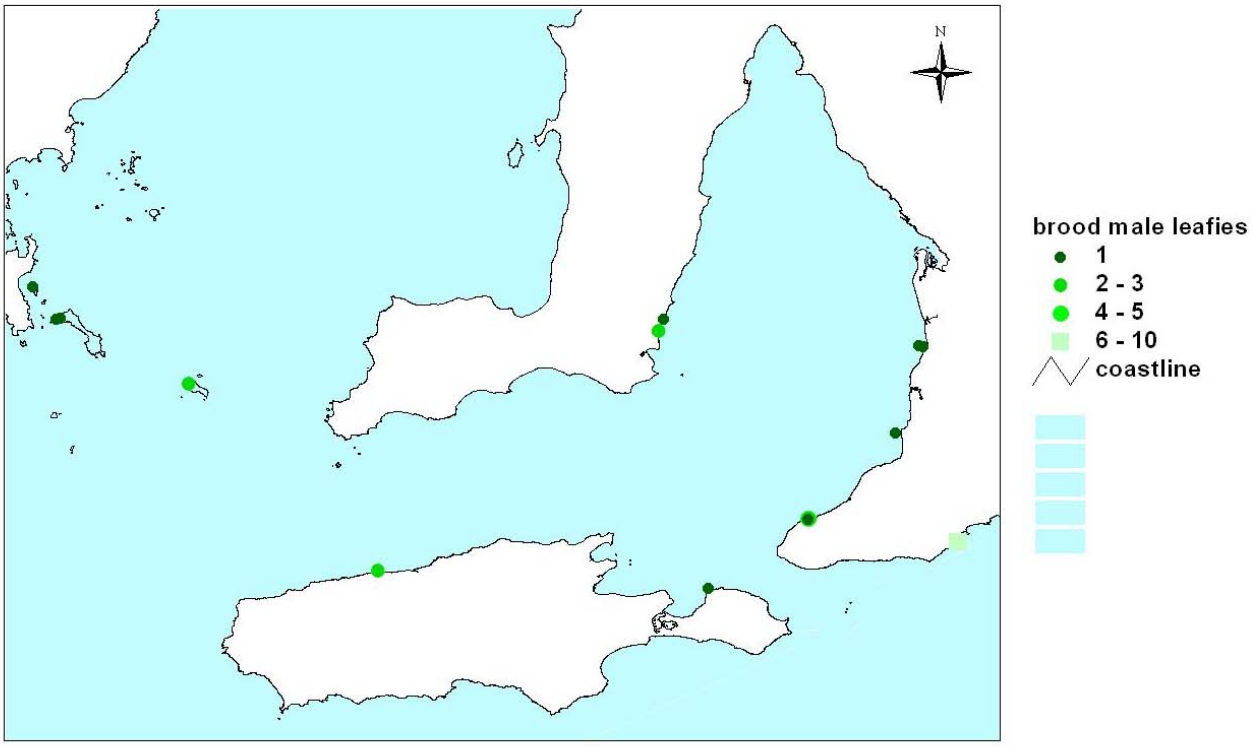
Map 2b: Numbers of seadragons per sighting, in the western part of Eyre (EYR) Bioregion, and in Spencer Gulf (SGF) Bioregion, to May 2005.



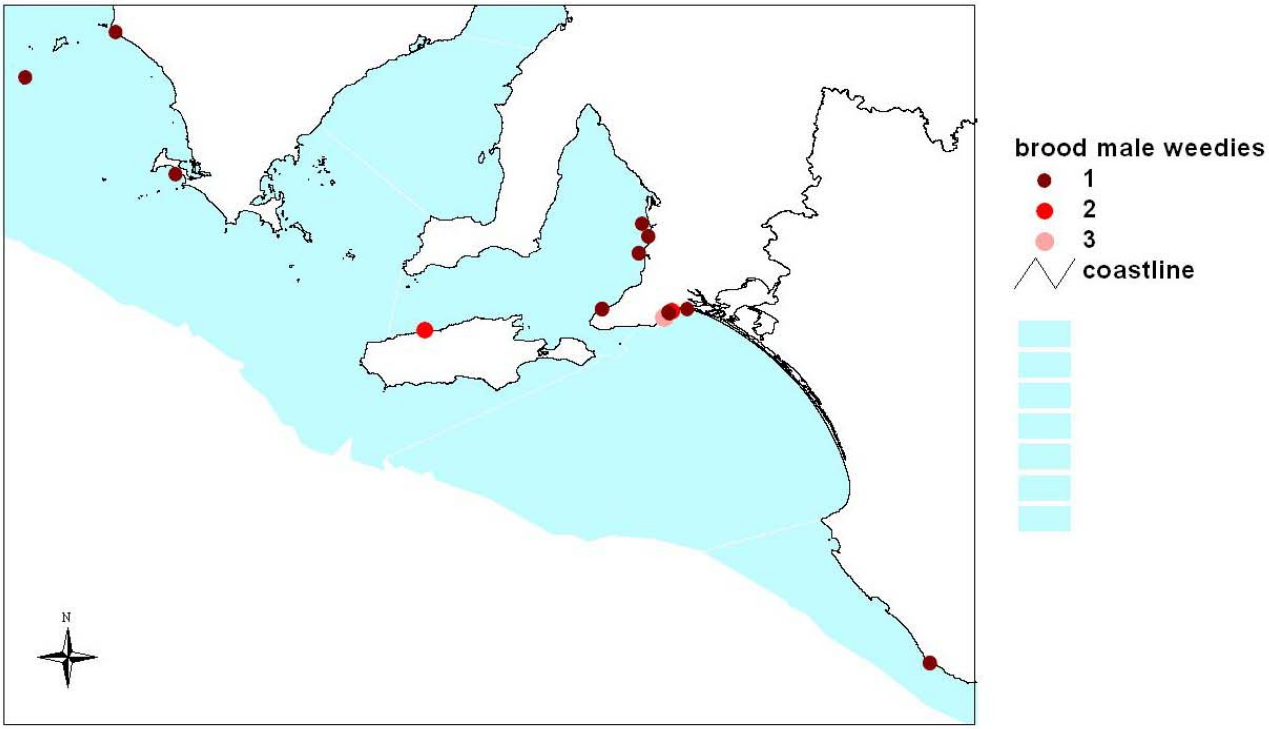
Map 2c: Numbers of seadragons per sighting, in the eastern part of Eyre (EYR) Bioregion, Gulf St Vincent (SVG) Bioregion, and northern part of Coorong (COR) Bioregion, to May 2005.



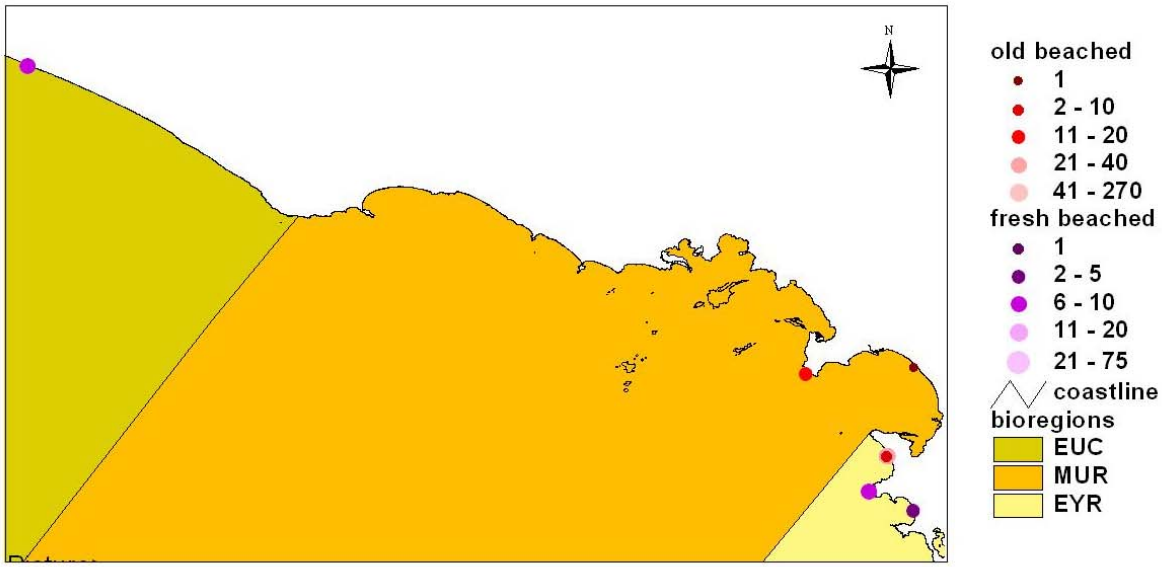
Map 2d: Numbers of seadragons per sighting, in the southern part of Coorong (COR) Bioregion and the western part of the Otway (OTW) Bioregion, to May 2005.



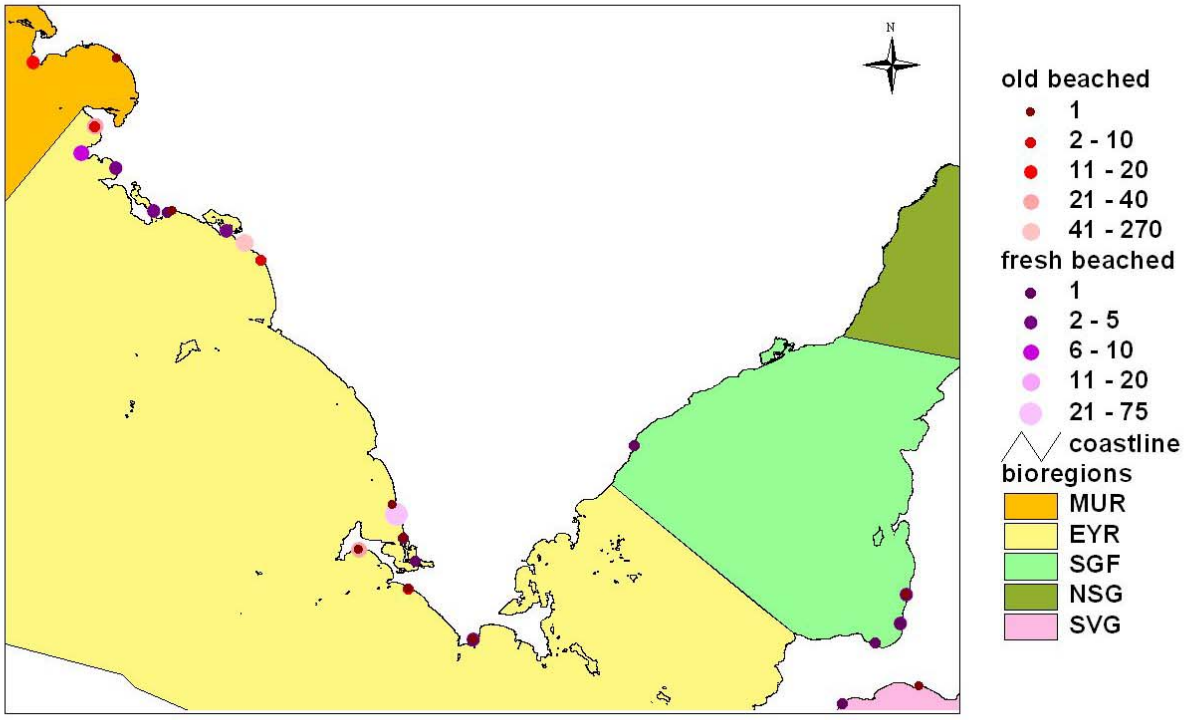
Map 3a: Numbers of brood male leafy seadragons per sighting, to May 2005.



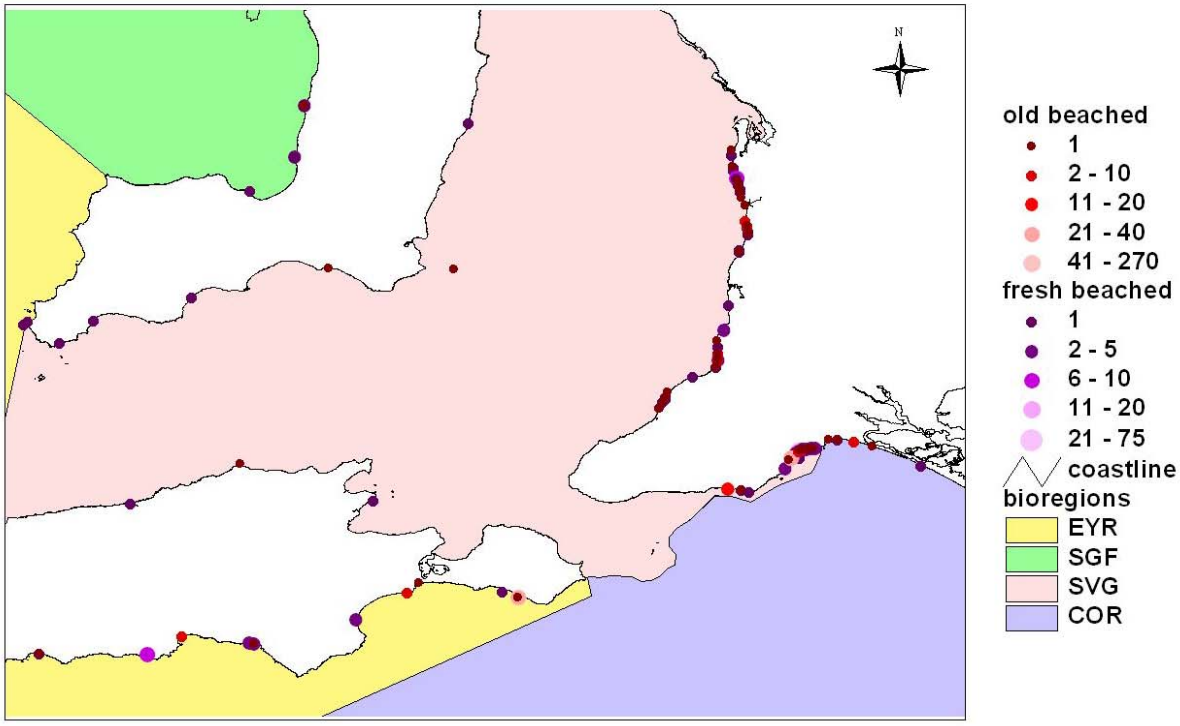
Map 3b: Numbers of brood male weedy seadragons per sighting, to May 2005.



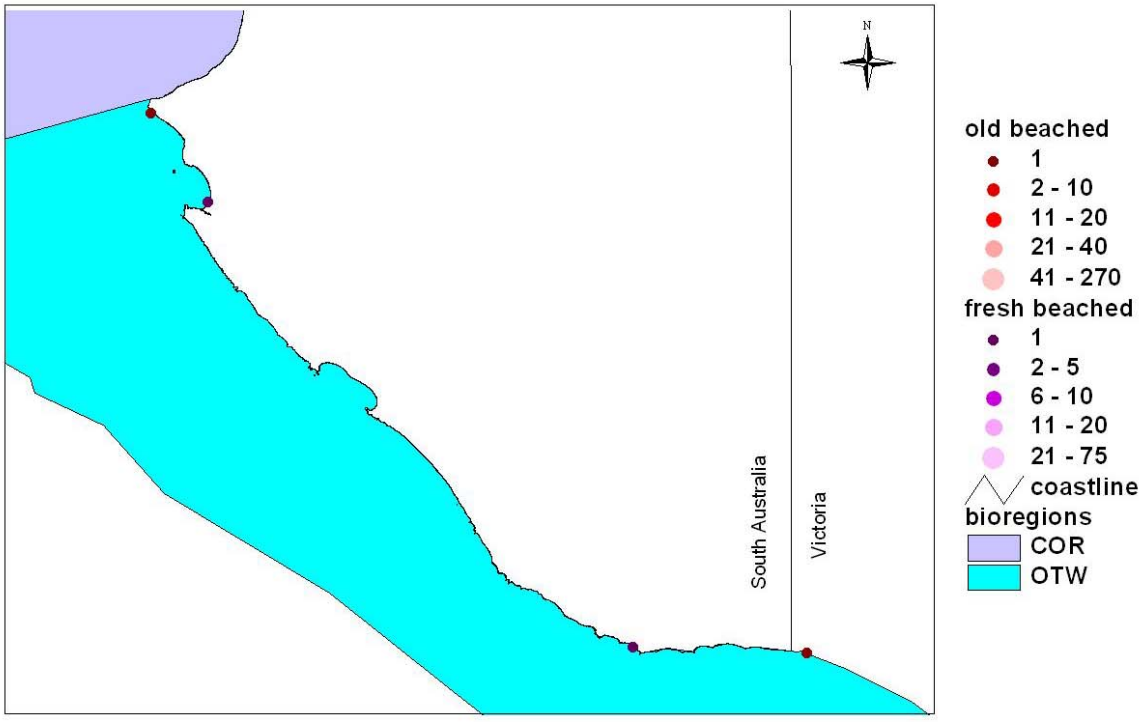
Map 4a: Numbers of seadragons per beachwash sighting, in Eucla (EUC) and Murat (MUR) Bioregions, to May 2005.



Map 4b: Numbers of seadragons per beachwash sighting, in the western part of Eyre (EYR) Bioregion, and in Spencer Gulf (SGF) Bioregion, to May 2005.



Map 4c: Numbers of seadragons per beachwash sighting, in the eastern part of Eyre (EYR) Bioregion, Gulf St Vincent (SVG) Bioregion, and northern part of Coorong (COR) Bioregion, to May 2005.



Map 4d: Numbers of beachwash seadragons per sighting, in the western part of the Otway (OTW) Bioregion, to May 2005.

Part 2: Historical Data

Dragon Search sightings pre-January 1990

The majority of records in the South Australian database to date, have been collected between 1995 and 2002, and all records from January 1990 onwards are discussed in **Part 1** of this report. All records older that 1990 have been removed to a separate database, and to date, there have been 97 such records submitted by Dragon Search reporters, as well as "aggregate" reports for sightings over a number of years. Summaries of the historical records are also provided below:

Gulf St Vincent (SVG) Bioregion

Around 75% of the 97 historical dragon Search records have come from the Gulf St Vincent bioregion, which are discussed below by date:

1989

Rapid Bay
- September: 1 leafy
- June: 1 weedy
- January: 1 weedy and 1 leafy (with empty egg cases)

Screwpile Jetty, Encounter Bay
- September: 1 weedy
- April: 1 weedy:

Near Snug Cove, Kangaroo Island
- November: 1 leafy

Second Valley
- February: 1 weedy

Seacliff Reef
- April: 1 weedy

1988

Rapid Bay
- December: 1 leafy
- October: 1 leafy
- September: 1 leafy
- August: 2 leafies
- February: 1 leafy, with a large sea louse attached

Screwpile Jetty, Encounter Bay
- October: 1 leafy
- November: 1 weedy

Bluff, Encounter Bay
- January: 1 leafy

Wright Island, Encounter Bay
- January: 20 leafies

Olivers Reef, Encounter Bay
- March: 1 weedy

Port Moorowie, Yorke Peninsula
- October: 1 leafy

1987

Rapid Bay
- February: two records (= 1 leafy and 2 leafies)

Screwpile Jetty, Encounter Bay
- December: two records (= 1 leafy and 2 leafies)
- November: 1 leafy

Bluff, Encounter Bay
- January: 1 leafy

Western River Cove, KI
- October: 2 records (1 leafy, 1 weedy)

Edithburgh, Yorke Peninsula
- April: 1 leafy

Stenhouse Bay, Yorke Peninsula
- August: 1 leafy

1986

Bluff, Encounter Bay
- October: 1 leafy
- September: 1 leafy
- February: 1 leafy

Second Valley
- February: 2 leafies

1985 *Encounter Bay* • December: 3 records (= 1 leafy; 3 leafies and 3 juvenile leafies) • October: 2 leafies *Bluff, Encounter Bay* • May*:* 2 records (= 1 leafy and 1 weedy)	**1984** *Rapid Bay* • February: 1 juvenile leafy observed during a night dive *Wright Island, Encounter Bay* • November: 12 weedies *Seaford Reef* • February: 3 leafies
1983 *Seacliff* • June: 2 records (1 weedy each)	**1982** *Fishery Beach, Cape Jervis* • August: 1 leafy *Seacliff Reef* • August: 1 leafy
1981 *Bluff, Encounter Bay* • May: 1 leafy *Seacliff Reef* • September: 1 weedy	**1980** *Rapid Bay* • May: 1 leafy *Wright Island, Encounter Bay* • September: 1 weedy *Bluff, Encounter Bay* • September: 1 leafy • July: 12 leafies *Seaford* • May: 1 weedy *Hallett Cove beach* • August: 30 weedies in the beachwash *Penneshaw Jetty, KI* • November: 2 leafies
1979 *Bluff, Encounter Bay* • October: 3 leafies • July: 7 leafies *Seaford* • December: 8 weedies	**1978** *Bluff, Encounter Bay* • February: 1 leafy *Port Noarlunga jetty* • February: 1 juvenile leafy in sand habitat, observed during night dive
1977	**1976** *Semaphore beach* • December: 1 weedy in the beachwash

Dr S. A. Shepherd, a scientist who has worked in the Encounter Bay area since 1965, reported that he has sighted up to 100 leafy seadragons at the Bluff and West Island since that time (over a total diving period of around 600 hours), stating that the leafies were always observed at the junction of seagrass (*Amphibolis*) and reef (with *Seirococcus axillaris* and *Cystophora* spp. etc).

Also of significance are historical records from the aforementioned scientist's benthic surveying during 1965 - 1971 (of "numerous weedies being observed between 5m and 15m depth, usually in *Posidonia* / *Amphibolis* " (S. Shepherd., pers. comm. to Dragon Search 2002), on the eastern side of upper Gulf St Vincent, from seaward of Outer Harbour, up to the Parham area. On the western side of Gulf St Vincent, during the same survey period 1965 - 1971, seadragons were recorded from deeper gulf waters off Kleins Point (e.g. 10m - 15m contour) up to the Muloorwurtie Point area south of Ardrossan, and including the Orontes Bank area off the Port Vincent region. There are no recent records of seadragons in the upper Gulf St Vincent area as far north as those recorded during the late 1960s. Although the significant decline in habitat quality of the upper gulf since that time may be partly responsible, it is notable that, with the exception of pipefish collections made in some nearshore areas by ecologist R. Browne and colleagues, no systematic surveys of the syngnathid fauna of upper Gulf St Vincent have been undertaken in recent years, and such surveying would be useful to determine whether seadragons still exist in that area.

Other historical Gulf St Vincent bioregion records reported by the same diver, include the following:

- **1973** - Second Valley: 1 leafy recorded in December
- **1965** - 8km east of Troubridge Island: 1 leafy recorded in seagrass habitat, during August
- **1965** - 25km offshore, southwest of Troubridge Island: 1 leafy recorded on seaweed-covered reef, in January
- **1965** - offshore from North Cape / Point Marsden (KI): 1 leafy recorded at 8m, on seaweed-covered reef, in December
- **1963** – 2km offshore from Cape D'Estaing (KI): 1 leafy recorded on seaweed-covered reef (*Ecklonia*, *Sargassum*, *Seirococcus*), in December.

Additionally, the research diver mentioned above (S. Shepherd) also provided several undated records from the SVG Bioregion, recorded between the late 1960s and early 1970s. These records include:

- 1 record of a leafy observed on reef at 12m – 14m, several km offshore from Yankalilla Bay, in boulder conglomerate community;
- an "aggregate" record of several leafy sightings at 7m – 15m in mixed seagrass (*Amphibolis* and *Posidonia*) and seaweed (*Cystophora* and *Sargassum*) habitat, during dives several kilometres along the coast, southeast of Lands End (Cape Jervis);
- 1 record of a leafy observed near the Kingscote Jetty, in rubble habitat;
- 1 record of a leafy observed at 40m depth, in reef habitat with *Ecklonia*, *Scytothalia* and other canopy browns, approximately 10km offshore and northwest of Cape Cassini (KI);
- 1 record of a leafy observed at the junction of sand and *Sargassum* /reef habitat, near Snapper Point, eastern Kangaroo Island.

Eyre (EYR) Bioregion

There have been 12 historical records from the Eyre bioregion submitted to Dragon Search, mostly by Dr S. A. Shepherd, who recorded seadragons during abalone surveys. These EYR records comprise the following:

- **1989** – Pondalowie Bay: 1 leafy recorded in March
- **1988** – Taylor Island: 1 leafy recorded at the junction of rock and sand, at 8m depth;
- **1987** – Ocean side of Coffin Bay (near Avoid Bay): 2 leafies recorded in the beachwash, in December;
- **1987 –** Thistle Island, north side: 1 leafy recorded at 10m;
- **1985 –** north of Greenly Beach (Coffin Bay region): 7 weedies and 7 leafies recorded in the beachwash, in January;
- **1980's** – north coast of Flinders Island: leafies (unspecified number) recorded at 12m – 14m during surveying throughout the 1980s;
- **1977** – Proper Bay (Port Lincoln): 1 leafy, recorded at 8m near the end of the sewage pipeline, on seagrass bottom with rock patches;
- **1963 –** Wedge Island: 1 leafy recorded in December, at 8m-10m, over rock habitat;

Additionally, a number of historical but undated records from the Eyre Bioregion have been reported, from abalone surveys undertaken by S. Shepherd in the 1980s. These records include:

- Northeast of McLachlan Point (Waldegrave Island): numerous leafies sighted at 22m on rocky bottom (with complex macroalgae communities), and 1 leafy observed north of McLachlan Point, on rocky platform at 12m;
- 1 leafy sighted at 5m – 7m in *Sargassum* forest, near Carcase Rock, north of MacLaren Point (off Lincoln National Park, south-eastern Eyre Peninsula).

Murat (MUR) Bioregion

Four historical records exist for the Murat Bioregion. These are 2 diving records of single adult leafies, recorded at Fowlers Bay, on the far west coast, in February and June 1986; and two beachwash records, one of a single adult leafy recorded from Rocky Point (near Ceduna), and one record of approximately 100 leafies and 100 weedies found on a beach at Corvisart Bay ("Back Beach") in January 1987 (see section on **Beachwash Records**).

Spencer Gulf (SGF) Bioregion

There have been several historical records from the Spencer Gulf bioregion submitted to Dragon Search, comprising the following:

- Tiparra Reef ("outside bottom"): numerous sightings of leafies at 11m, on rocky bottom with seagrass patches, in an area of moderate currents (S. Shepherd, pers. comm. to Dragon Search, 2002);
- Port Victoria: 2 dive records (1 adult weedy observed February 1985; 1 adult leafy observed January 1981);
- Corny Point: 1 weedy adult, observed during a dive in April 1988.

Otway (OTW) Bioregion

The historical records from the Otway Bioregion include:

- An undated record from beachcombing at Nora Creina Bay (1 adult seadragon with eggs observed);
- 2 records from Carpenters Rocks (lower South East SA): 2 adult leafies and 1 adult weedy observed during dives in June 1980.

Historical Records from SA Museum

Apart from the above historical records included in the South Australian Dragon Search database, the South Australian Museum has provided 72 additional historical records to Dragon Search, which describe an assortment of leafy and weedy seadragon sightings from around South Australia.

The following summarises the South Australian Museum records (almost all of which were beachwash specimens), according to location, from west to east. Of particular note is the record of a weedy seadragon and 3 leafy seadragons recorded in 1985, caught live in a trawl at 12m – 20m, from Douglas Bank in upper Spencer Gulf, as this is the only record known of seadragons occurring so far north in Spencer Gulf.

Location / Marker	**Bioregion**	**Sighting Details for Records of Beachwash Specimens**
"West Coast of SA"		• 4 freshly dead weedies, date unknown
Coffin Bay National Park	EYR	• 1 fresh leafy, recorded from Mt Dutton Bay, 1940
Port Lincoln	EYR	• 1 fresh leafy, recorded 1968 • 1 fresh leafy, date unknown
Tumby Bay	EYR / SGF	• 2 records, each of 1 fresh leafy, recorded February 1966
Neptune Island	EYR	• 1 fresh weedy, March 1916
Cape du Couedic, KI	EYR	• 1 fresh weedy, recorded 5 miles south of Cape du Couedic, March 1951
D'Estrees Bay, KI	EYR	• 1 fresh leafy, December 1967
Douglas Bank, upper Spencer Gulf	USG	• 1 weedy and 3 freshly dead leafies (recorded by "*Other*" sighting means), trawled at 12m – 20m, at Douglas Bank, in November 1985.
Wallaroo	SGF	• 1 old weedy, July 1936
Port Minlacowie	SGF	• 1 fresh leafy, May 1932
"Gulf St Vincent" (locations unspecified)		• 2 freshly dead brood male weedies, recorded 1920 • 13 fresh weedies, recorded 1920 • 1 fresh weedy, May 1953
"Wattle Point", Yorke Peninsula	SVG	• 1 fresh leafy, September 1916
Stansbury	SVG	• 1 fresh leafy, February 1930 • 1 fresh leafy, July 1949
Largs Bay	SVG	• 2 fresh weedies, December 1930
Semaphore		• 1 old weedy, January 1935
Port Adelaide area	SVG	• 1 old leafy, March 1916

Location / Marker	Bioregion	Sighting Details for Records of Beachwash Specimens
Grange	SVG	• 1 fresh weedy, November 1915 • 1 old weedy, 1915 (month unknown) • 1 old weedy, February 1917
Henley Beach	SVG	• 2 records, each of 1 old weedy, from March 1925 and September 1933 • 2 records, each of 1 fresh weedy, from January 1925 and February 1935
Glenelg	SVG	• 4 records, each of 1 fresh weedy, from January 1916, May 1917, August 1920 and September 1964. • 1 old weedy, date unknown
Brighton	SVG	• 4 records, each of 1 fresh weedy, recorded in December 1917, October 1948, February 1952, and 1928 (month unknown) • 4 records, each of 1 old weedy, recorded in April 1912, June and July 1923, and February 1938
Marino Rocks / Marino	SVG	• 1 old leafy, recorded May 1972 • 1 fresh weedy, recorded April 1930
Aldinga	SVG	• 2 records, each of 1 fresh leafy, recorded May 1962 and January 1973; • 1 fresh leafy, found dead in seaweed, in February 1988 • 1 fresh weedy, recorded September 1920
Sellicks Beach	SVG	• 1 old weedy, date unknown
Normanville	SVG	• 1 old weedy, recorded May 1912
Encounter Bay	SVG	• 1 old leafy, recorded at Victor Harbor, December 1912; • 1 old weedy, recorded at Victor Harbor, February 1933 • 1 fresh leafy (male with eggs attached), recorded at Wright Island, January 1967
Port Elliot	SVG / COR	• 1 old weedy, recorded February 1937
Coorong	COR	• 1 old weedy, recorded April 1936
Robe	OTW	• 1 old weedy, recorded August 1922
(unspecified locations within South Australia)		*Freshly dead leafies:* • 3 records from 1920, one of 3 leafies; the others of single leafies; • 1 record from 1983 *Freshly dead weedies:* • 3 records of single animals, from January 1914, July 1931, and 1937 (month unknown) *Old weedies:* • 3 records of single animals, from January 1914, September 1917 and September 1938