Dragon Search: Public Report

Summary of National Sighting Data, 1990 to 2005

by J.L. Baker, Marine Ecologist
for the Dragon Search Community - Based Monitoring Program

Acknowledgements

The following organisations and programs have supported the Dragon Search Program:

This report discusses the seadragon sightings recorded by Dragon Search divers and beachcombers in Western Australia, South Australia, Victoria, Tasmania and New South Wales, over the period January 1990 to May 2005.

This report should be cited as: Baker, J.L. (2009) ***Dragon Search Public Report - Summary of National Sighting Data, 1990 to 2005.*** **Report for Dragon Search Community - Based Monitoring Program. Published by Reef Watch, South Australia.**

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1. Distribution of Sightings by State

Table 1 shows the total number of sightings that have been recorded from each State during the Dragon Search Program, and the total number of seadragons recorded (including an unknown number of repeat sightings of the same animals). South Australian sightings have been divided into two parts, in keeping with the structure of the South Australian report *Summary of South Australian Sighting Data, to May 2005* (Baker, 2005b), in which the large number of sightings prior to the nominal date of January 1990 were analysed separately, in the section on 'historical records'. The majority of the historical sightings from the 20th century were collated by the South Australian Museum and the West Australian Museum, and these are discussed separately, in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf). For other States, the small numbers of records prior to 1990 were moved to separate databases, and these have not been included in the summary statistics (**Table 1**). However, undated records presumed to be post - 1990 have been included.

Table 1: Summary of leafy and weedy seadragon sightings in each State during the Dragon Search Program

State	No. of pre - 1990 records	Time period	Total no. of sightings 1990 - 2005	No. of sightings with both species	Total no. of seadragons sighted (incl. repeat sightings)
NSW	20	Jan 1990 - Jun 2005	629	-	1893
VIC	5	Jun 1995 - Apr 2005	151	2	558
SA	-	Jan 1990 - May 2005	827[1]	79	2390
SA (pre-Dragon Search)	97	Dec 1963 - Nov 1989	-	1	407
TAS	8 (+ 23 undated)	Apr 1990 - Apr 2005	220	-	509
WA	8	Jul 1990 - Apr 2005	515	21	1178

Table 2: Species specific summary of seadragon sightings in each State during the Dragon Search Program

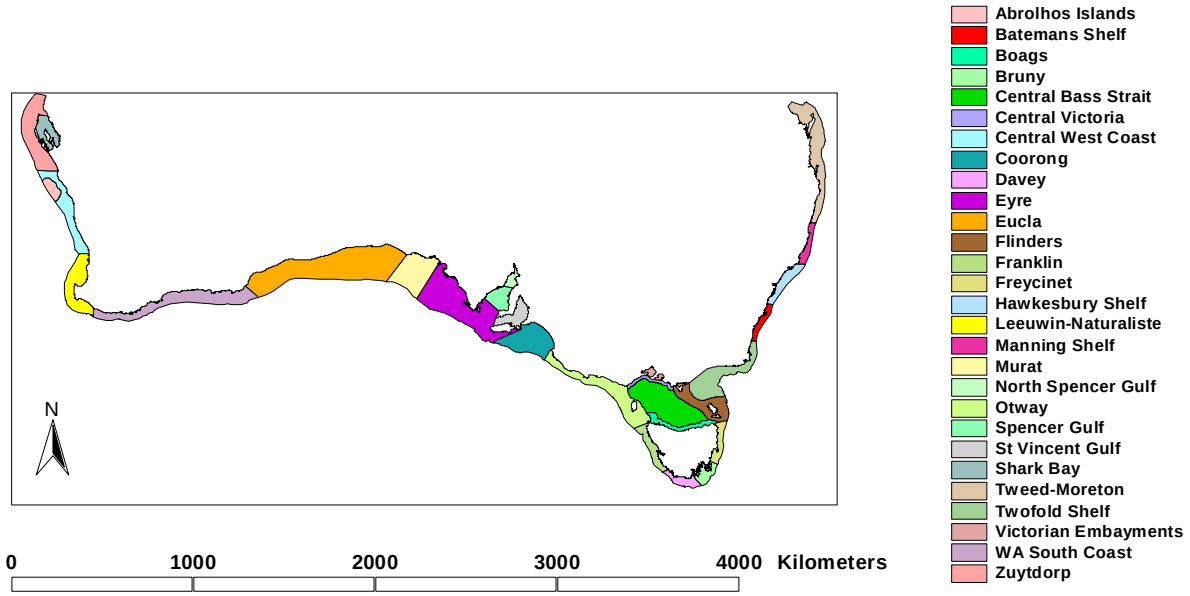
State	Time period	Total no. of seadragon sightings		Total no. of seadragons sighted (incl. repeat sightings)	
		Leafy	**Weedy**	**Leafy**	**Weedy**
NSW	Jan 1990 - Jun 2005	-	629	-	1893
VIC	Jun 1995 - Apr 2005	18	133	58	500
SA	Jan 1990 - May 2005	508	394	1104	1286
SA (pre-Dragon Search)	Dec 1963 - Nov 1989	73	25	230	177
TAS	Apr 1990 - Apr 2005	2	218	2	507
WA	Jul 1990 – Apr 2005	158	371	308	871

[1] Includes four sightings of other syngnathids, in which seadragons were not seen.

Table 2 summarises the numbers of sightings of leafy and weedy seadragons in each State, including repeat sightings of the same seadragons in some areas. The totals include verified records in which both species were observed. It is noted that both the SA and WA databases contain several records of mass aggregations of seadragons, some referring to live animals in the water and others to dead specimens on the beach. 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

The locations of marine bioregions in southern Australia, as specified by the Commonwealth (IMCRA Technical Group, 1998) are shown in **Map 1**. For reporting purposes, these bioregions can be divided into South-Eastern (NSW, Tasmania, Victoria, and SE South Australia); Central (SE South Australia through to the eastern Great Australian Bight) and South-Western (western Great Australian Bight through to the central west coast of WA).



Map 1: Marine Bioregions across southern Australia (IMCRA Technical Group, 1998)

In ***New South Wales***, 74 % of sightings came from the Hawkesbury Shelf bioregion (HAW); 21 % from Bateman's Shelf (BAT); 4 % from the Twofold Shelf (TWO), which extends south into Victoria, and 1 record came from the Manning Shelf (MAN), the most northerly bioregion in NSW in which weedy seadragons have been sighted. There were no records from the Tweed-Moreton (TMN) bioregion, near the Queensland / New South Wales border. The NSW Dragon Search reports (Baker, 2000a; Howe, 2002) discuss locations in each NSW bioregion in which seadragons have been sighted.

In ***Victoria***, 83 % of sightings (and approximately 93 % of the total number of seadragons sighted) have come from locations in the Victorian Embayments (VES), a bioregion that includes Port Phillip Bay, Western Port Bay, and the waters of Corner Inlet and the Nooramunga area. Almost 10 % of sightings (4 % of seadragons) have been recorded from the Victorian section of the Otway (OTW) Bioregion (the total area of which includes the waters off the far north-western tip of Tasmania, south-western Victoria and south-eastern South Australia, Western Bass Strait and King Island). Four percent of sightings (2 % of seadragons) came from the Central Victorian (CVA) bioregion, which

comprises an approximately 16 km wide strip (from coast to sea) of waters between the Cape Otway National Park area in the west, to Warratah Bay in the east. For the remaining, 3 % comprise of one sighting recorded from the Gippsland area (Cape Conran) in the Twofold Shelf Bioregion (TWO), which extends from eastern Victoria / eastern Bass Strait into southern New South Wales, and three sightings recorded from the Victorian section of the Flinders bioregion (FLI), which comprises the waters between north-eastern Tasmania and the southernmost part of Victoria, and also includes islands of the Furneaux Group, such as Flinders and Cape Barren Islands (**Map 1**). Not surprisingly, to date no sightings have been recorded offshore in the Central Bass Strait (CBS) Bioregion, which is directly seaward of the Central Victorian Bioregion, and not connected to land. The Victorian Dragon Search report (Baker, 2005c) discusses locations in each Victorian bioregion in which seadragons have been sighted.

In ***Tasmania***, approximately 70 % of sightings (and 71 % of the total number of seadragons sighted have come from locations in the Bruny Bioregion, on the south-eastern side of Tasmania; 14 % of sightings (12 % of seadragons) have been recorded on the east coast (Freycinet Bioregion); 8 % of sightings (7 % of seadragons) from northern Tasmanian locations in the Boags Bioregion, and 6 % of sightings (9 % of seadragons) have come from the Flinders Bioregion, comprising the waters between north-eastern Tasmania and south - eastern Victoria, including islands of the Furneaux Group. Very few sightings have been recorded from the west coast (Franklin Bioregion: < 1 % of sightings and seadragons) and the Otway Bioregion (one sighting), which includes the waters off the far north-western tip of Tasmania, south - western Victoria and south-eastern South Australia, Western Bass Strait and King Island (IMCRA Technical Group, 1998). No sightings have been recorded from the more remote (and largely inaccessible) south-western area of Tasmania (Davey Bioregion).

Table 3: Bioregional summary of seadragon sightings in South Australia

Bioregion	Percentage (%) of sightings	Percentage (%) of seadragons sighted
Gulf St Vincent (GSV)	83 (= 687 reports)	68
Eyre (EYR)	9	24
Coorong (COR)	2	1
Otway (OTW)	2	2
Spencer Gulf (SGF)	1.8	0.7
Murat (MUR)	1	3.5
Eucla (EUC)	(1 report)	0.89

In ***South Australia***, **Table 3** shows the percentage of sightings and percentage of seadragons sighted for each bioregion, to May 2005. The relatively high percentage of seadragons from the Eyre bioregion reflects several records in which masses of dead seadragons were seen in the beachwash.

For the separate species, 89 % of leafy seadragon ('leafies') sightings and 77 % of weedy seadragon ('weedies') sightings have come from the Gulf St Vincent (GSV) bioregion, with approximately 31 % of the GSV sightings of weedies being beachwash reports. Within the GSV bioregion, approximately 33 % of leafy seadragon sightings and 27 % of weedy seadragon sightings 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. Approximately 21 % of leafy seadragon records from the GSV 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, so these records include a number of repeat sightings of the same animals on different dates. Within the GSV Bioregion, approximately 18 % and 11 % of weedy and leafy seadragon records, respectively, have come from dive sites in Encounter Bay and around its islands, as well as a number of beachcombing records in the Victor Harbor area. Parts of Encounter Bay are popular for diving and at one site, repeat dives have been undertaken to view resident leafy seadragons. Encounter Bay is at the south-eastern edge of the GSV 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 GSV Bioregion.

Of the sightings 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. To date, the small number of sightings (n = 17, between January 1990 and May 2005) from the Otway 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 and weather conditions that limit dive opportunities, even in limestone reef areas containing 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 South Australian Dragon Search Report (Baker, 2005b) discusses the locations in each SA bioregion in which seadragons have been sighted in more detail.

In ***Western Australia***, 45 % percent of sightings (and approximately 57 % of the total number of seadragons sighted) have come from locations in the WA. South Coast (WSC) Bioregion, eastwards from the Walpole area on the south coast, including Albany, Bremer Bay and Esperance; 40% of sightings (35 % of seadragons) have been recorded in the Leeuwin – Naturaliste Bioregion (LNE) from the Perth area to the south-western end of WA., including Mandurah, Bunbury, Margaret River and Augusta; and 13% of sightings (7 % of seadragons sighted) came from the Central West Coast (CWC) Bioregion, from Kalbarri south to the Perth metropolitan area. The remaining 2 % of sightings include three sightings from the Abrolhos Islands Bioregion (ABR), one sighting from the Eucla Bioregion (Great Australian Bight) and one sighting (not verified) from the Shark Bay Bioregion. Three records of 'seadragons' from further north, in the Pilbara Inshore (PIN) and Canning (CAN) bioregions may refer to the tropical species Ribboned Seadragon (Ribboned Pipehorse) *Haliichthys taeniophorus* (Kuiter, 2003). The WA Dragon Search report (Baker, 2002c) discusses locations in each WA bioregion in which seadragons have been sighted.

Weedies and Leafies Sighted Together

In ***South Australia***, approximately 91 % of the 79 sightings of both species together have come from two records each from Edithburgh (south-western GSV), Second Valley (Fleurieu Peninsula), and Encounter Bay; and one each from Stenhouse Bay (bottom of Yorke Peninsula), Sellicks (southern metropolitan), and Western River Cove (northern Kangaroo Island). For the Eyre Bioregion, three reports of both species sighted together came from Anxious Bay (eastern Great Australian Bight / western side of Eyre Peninsula), and one report each from Vivonne Bay and Seal Bay (both on southern Kangaroo Island). One record of both species came from the Murat Bioregion (Corvisart Bay, also

known as ‘Back Beach’, in the eastern GAB) and one from Otway Bioregion (Carpenter Rocks, in the lower south-east).

In ***Western Australia***, approximately two thirds of the sightings of both species together have come from locations in the WSC Bioregion (e.g. Bremer Bay, and sites near Esperance), six sightings have come from various locations south of Perth (LNE Bioregion), and one sighting was recorded in the CWC Bioregion (Illawong area).

In ***Victoria***, the two records of both species sighted together, came from the Portsea and Flinders areas both in the VES Bioregion.

Maps 2a, 2b, 2c, and **2d** in **Appendix 1** summarise the number of weedy and leafy seadragons sighted in each of the bioregions in the southern Australian States, to mid-2005.

3. Sites of Frequent Reporting

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. There are various areas in each State where seadragons have been sighted regularly 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 that 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 frequently. Many of the locations cited below are likely to reflect greater knowledge of the Dragon Search program amongst divers (and a relatively greater number of divers) in the more populated (e.g. metropolitan) and accessible areas.

Examples in each State of locations from which the bulk of the Dragon Search records have come, include:

In ***Western Australia***, many of the records have come from popular dive spots around the Perth metro area, North Mole (Fremantle area), Marmion Marine Park and surrounds (e.g. Hillary’s Boat Harbour), Mandurah, and south coast dive spots such as Bremer Bay, and around the Albany and Esperance area.

In ***South Australia***, the more popular and accessible areas for diving include parts of the metro area (e.g. Glenelg; Seacliff, and artificial reefs); southern Fleurieu (Port Noarlunga and particularly Rapid Bay and Second Valley); Victor Harbor (e.g. various reefs and islands in Encounter Bay), and Yorke Peninsula (e.g. jetties in western and south-western GSV). In SA, the geographical distribution of sightings also reflects the contribution of a number of records (including repeat sightings) from sites on northern and north-eastern Kangaroo Island where seadragons are observed regularly during dive tours. There are also several beachcombers who consistently provide records from the metropolitan area (e.g. Henley Beach) and southern Fleurieu (e.g. Sellicks), as well as a larger number of beachcombers in that GSV region, compared with more remote locations.

In ***Victoria***,there are various locations near the entrance to Port Phillip Bay where seadragons have been sighted regularly 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 and/or contain popular features for diving, the latter particularly including various pier and reef dive sites at the bottom of the Mornington Peninsula (e.g. Portsea and Flinders) and Bellarine Peninsula (Queenscliff). These popular dive spots in the VES bioregion contrast with the limited area available for diving in both the Flinders and Central Bass Strait Bioregions (i.e. with very little or no coastal area in the Victorian sections of those bioregions).

In ***Tasmania***, sites where seadragons are observed regularly include the Tasman Peninsula area in the south-eastern region (including popular dive spots around Eaglehawk Neck, Port Arthur, Fortescue Bay); Hobart area (Kingston Beach, Tinderbox, Blackman's Bay, South Arm); Bruny Island; and sites on the north-east coast, such as St Helens and Bicheno. The distribution of sightings in Tasmania reflects promotion of Dragon Search amongst beachwalkers / beachwalking groups that visit particular sites, such as beaches on the north-eastern side of Tasmania, and on Flinders Island. The distribution of sightings also reflect the relative inaccessibility of sites on the west and south-west coasts, and the limited area available for diving in both the Otway and Flinders Bioregions (i.e. mainly islands, with very little coastal area in the Tasmania sections of those bioregions).

In ***New South Wales***, dive sites are around the Sydney area (South Head and North Head, Manly, Bondi, Maroubra, La Perouse, Kurnell, Cronulla), and Bundeena, Wollongong, Shellharbour, Kiama, Jervis Bay (the latter in particular), Tathra and Eden.

In each State, the relatively small number of records from remote areas away from (i) major population centres; (ii) locations where Dragon Search has been heavily promoted or known to the community; (iii) popular diving locations and (iv) popular beaches, do not indicate that seadragons are less abundant at some of the more remote locations, compared with more accessible sites. In SA, for example, the large number of weedies and leafies that have been recorded in the beachwash at various times from some parts of the eastern Great Australian Bight (see below, and also ***Summary of South Australian Sighting Data, to May 2005*** (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf), indicates that seadragons are relatively abundant in at least some parts of that remote region. 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 western SA and the 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.

4. Geographical Limits of Seadragon Sightings

Western Australia: Hutchins and Swainston (1986, 2001) and Edgar (2000) reported a northern distribution limit of Geraldton for weedy seadragons in WA To date, the records in the Western Australian Dragon Search database support this distribution limit, with the most northerly sighting of the 342 weedy records to date coming from the Abrolhos Islands (west of Geraldton). Hutchins and Swainston (1986, 2001) and Edgar (2000) also reported that Lancelin is the northern limit of leafy seadragon distribution in WA However, the WA Dragon Search database includes reports of leafy sightings at more northerly locations than Lancelin, including Grey, Cervantes, Illawong, Port Denison, Dongara, Green Head, Geraldton, and the Abrolhos Islands. The northern distribution of leafy seadragon in WA should therefore be revised to include locations as far north as the Geraldton / Abrolhos Islands area.

South Australia: The most westerly record in the SA Dragon Search 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 seven adult weedies). The most northerly Dragon Search sightings in the database records since 1990 have come from the Port Hughes jetty, 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 sampling of fish fauna in Spencer Gulf as part of a SARDI research project during the early 2000s, 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.). During more recent bycatch sampling in the Spencer Gulf Prawn Trawl Fishery, a Weedy Seadragon specimen was recorded north of Point Riley, in the Tickera area (Currie et al., 2009). This may represent the most northerly record of weedy seadragons from research sampling in Spencer Gulf. However, there is a record in the 'historic' database of one weedy and three leafies reportedly caught (live) in a trawl at 12m – 20m, at Douglas Bank, upper Spencer Gulf, in November 1985. As the trawls were of a short duration (10 - 15 min.) and slow speed (4 knots), the reporter considered that the seadragons came from the local area. No other records of seadragons this far north in Spencer Gulf waters is 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 observed commonly, 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 both reef ledge habitats with sponges as well as adjacent seagrass, off the Cowell area on the mid western side of Spencer Gulf. Also, there is a 2002 snapper survey report, of a weedy seadragon having been observed out of the mouth of Franklin Harbour (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 from Spencer Gulf to date.

In GSV, there are reports from benthic surveys during 1965 – 71 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 to the Parham area. On the western side of GSV, during the same survey period 1965 - 71, seadragons were recorded from deeper gulf waters off Kleins Point (e.g. 10 m – 15 m contour) up to the Muloorwurtie Point area south of Ardrossan, and including the Orontes Bank area in 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 two 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 (three reports of single leafies), West Lakes (one weedy) and the Tennyson area (five reports, four of which were single weedies, and one of six leafies). The most northerly dive records in the Dragon Search database from the upper eastern side of GSV are all from 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 GSV. 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 10 m south of the Ardrossan – Port Prime line). 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 an artificial reef, from where nine seadragon sightings have been reported), and Dragon Search divers do not regularly dive in upper GSV - 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 GSV to determine whether the abundance of seadragons observed during the 1960s still exists, or whether habitat changes over the ensuing decades 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 in recent years, survey data on pipefish have been collected from a number of areas in South Australia, including northern GSV (e.g. Browne, 2003, 2004; Smith, 2005, and K. Smith, unpublished data 2004 - 2006). To date, the most southerly records for seadragons recorded in the Dragon Search database have come from a beach at Nelson, near the SA / Victorian border (one weedy recorded in the beachwash, June 2001), and from the Port MacDonnell area (a beachwash record of one weedy and one diving record of six weedies, both sightings from March 2000). The most southerly records of leafy seadragons in the Dragon Search database have been two reports of leafies from the SA 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 Carpenter Rocks, of two adult leafies in each sighting. There is also a record of two leafy seadragons from Carpenter Rocks (recorded June 1980), in the 'historical' database of older, pre-Dragon Search records. (See http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

Victoria: The most easterly Dragon Search record to date is a weedy seadragon specimen found on a beach east of Cape Conran, in the Twofold Shelf Bioregion, which extends into southern New South Wales.

New South Wales: The most northerly sighting in the Dragon Search database is a single record of a weedy from South West Rocks (between Port Macquarie and Coffs Harbour), in the Manning Shelf Bioregion.

Tasmania: Of note are two records of leafy seadragons from northern Tasmania (which is not part of the published distribution). The records are from Stanley (January 2003) and Rocky Cape (September 1997). The diver who submitted the record from Stanley reported that the animal was definitely a leafy seadragon, not a weedy. It is feasible that leafy seadragons might occasionally occur in northern Tasmania, given that they are also found (in low numbers) on the other side of Bass Strait, in Victoria.

5. Sighting Details

Table 4: Seasonal summary of seadragon sightings in each State

State	Time period	Percentage (%) of seadragon sightings per season (figures in parentheses are % of total number of seadragons sighted)			
		Summer	**Autumn**	**Winter**	**Spring**
NSW	Jan 1990 - Jun 2005	35 (32)	27 (28)	18 (22)	20 (18)
VIC	Jun 1995 - Apr 2005	34 (34)	34 (39)	13 (12)	19 (15)
SA	Jan 1990 - May 2005	43 (48)	24 (19)	13 (16)	20 (17)
WA	Jul 1990 – Apr 2005	47 (49)	24 (20)	9 (15)	20 (16)
TAS	Apr 1990 - Apr 2005	41 (33)	18 (18)	19 (24)	22 (25)

Table 4 shows the seasonal distribution of seadragon sightings in each State. In all States, one third or more of sightings were made during the summer months. In **Victoria**, one third of sightings were made in summer and one third in autumn. In all States, fewer sightings were made during winter months, as would be expected due to the opportunistic nature of the reporting. Neither relative frequency nor abundance of seadragons per sighting location can be discussed meaningfully 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 surveyed systematically 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 reporting. Apart from the smaller number of recreational dives that are taken in winter in most areas (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 on **Brooding Male Seadragons. Figure 2** shows a monthly summary of seadragon sightings.

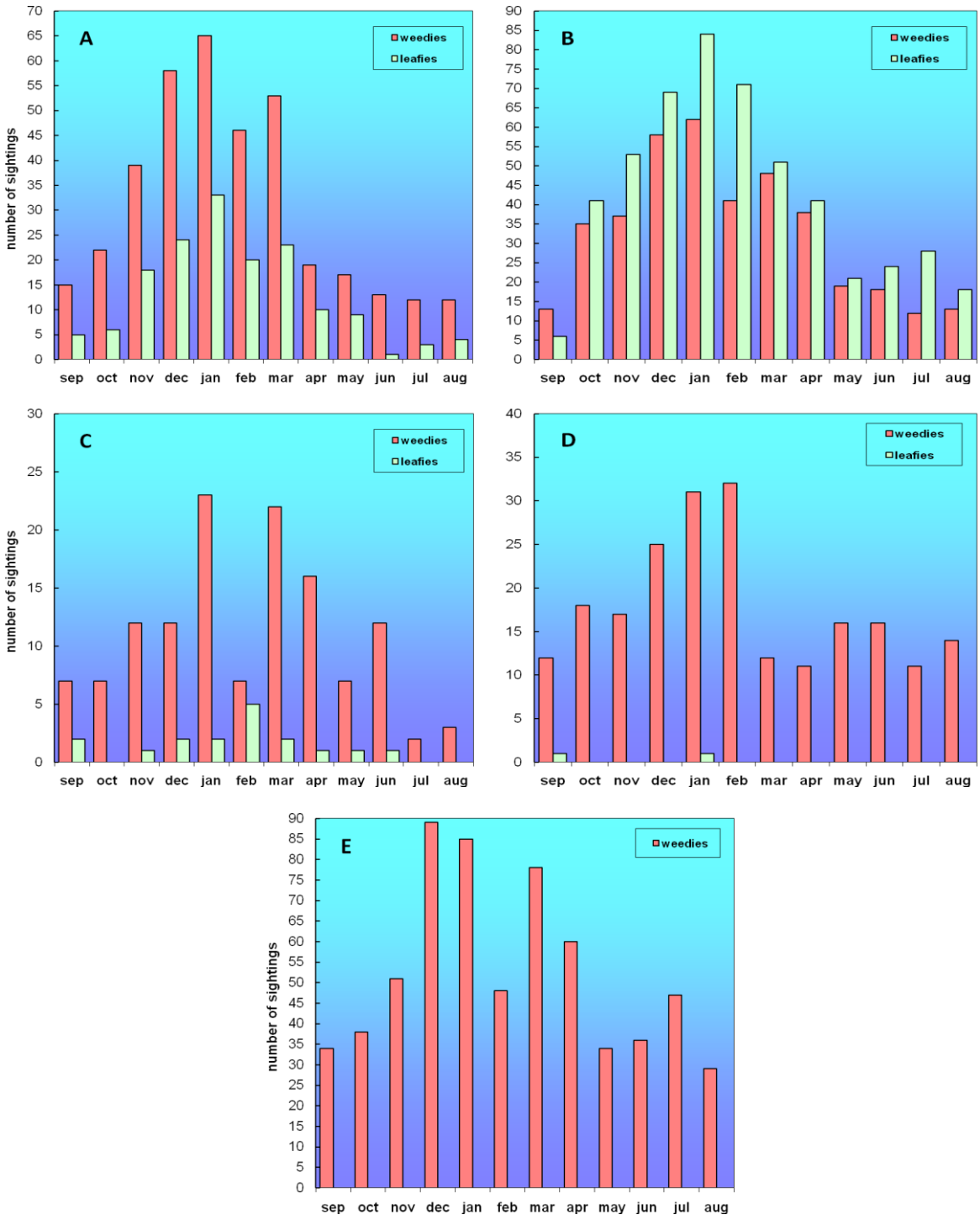


Figure 2: Monthly summary of weedy and leafy seadragon sightings. A = WA; B = SA; C = VIC; D = TAS; E = NSW (n.b. Locations and Years Combined, 1990 - 2005)

Summary of Sighting Modes: For each State, **Table 5** summarises the percentage of the total number of sightings (and the total number of seadragons sighted) that was recorded by each of the sighting modes: SCUBA diving during the day, night diving, snorkeling, beachcombing, and other means.

Table 5: Summary of seadragon sightings by sighting mode in each State

State	**Time period**	**Percentage (%) of sightings by sighting mode** (figures in parentheses are percentage of total number of seadragons sighted)				
		SCUBA - day	**SCUBA - night**	**Snorkel**	**Beachcombing**	**Other**
NSW	Jan 1990 - Jun 2005	77 (89)	< 1 (< 1)	2 (2)	20 (8)	< 1 (< 1)
VIC	Jun 1995 - Apr 2005	63 (74)	< 3	16 (18)	17 (5)	<2
SA	Jan 1990 - May 2005	70 (56)	2 (6)	1 (0.5)	25 (36)	1 (< 0.5)
TAS	Apr 1990 - Apr 2005	74 (70)	3 (9)	1 (4.5)	20 (15)	< 1 (< 1)
WA	Jul 1990 - Apr 2005	62 (57)	-	11 (18.5)	24 (13)	3 (12)

SCUBA divers accounted for more than 60 % of the reports in each State, with snorkellers contributing an additional 16 % and 11 % of the reports in Victoria and WA respectively. Around 20% of the records in each State came from beachcombers. The reports for each State (e.g. Baker, 2002a, 2002c; Howe, 2002; Baker 2005a, 2005b, 2005c) discuss locations where records were collected by each of the sighting modes. In South Australia, the large percentage of seadragons sighted by beachcombers, relative to the number of sightings by that mode, reflects the fact that aggregations of dead leafies and weedies (including large numbers, in some cases) were reported in some of the beachcombing records. This occurred predominantly during the two 'pilchard kill' events in SA waters during the late 1990s, however an older report, from 1987, also exists. Such records boost the total number of seadragons sighted by that mode. Also in SA, the percentage of seadragons sighted during night diving is relatively high due to one very large aggregation of leafies observed during a single night dive. Similarly in Tasmania, four of the eight night diving records contained aggregations of more than three seadragons (20 in one case). In Victoria, the small number of seadragons sighted by beachcombers, relative to the number of sightings by mode, reflects the fact that mainly single specimens were found in all but three sightings, compared with SCUBA diving, during which several large groups were recorded. In WA, the relatively large number of seadragons sighted by 'Other' mode, reflects a large aggregation of leafies (about 100) seen by a fisher working at night off Michelmas Reef (Albany area), and another aggregation of about 20 weedies (and 36 Western Australian seahorses) caught in a purse seine net, south west of Breaksea Island (also in the Albany area), and released alive.

To date, the number of records by *Other* sight modes is as follows: NSW = 2; VIC = 3; TAS = 2; SA = 9; WA = 16. These reports include several fishing records, in which seadragons were accidentally caught in nets (e.g. trawl nets, purse seine nets), on lines, or in pots or traps, and released alive where possible. A few records for which *Other* sighting mode was specified, included seadragons seen floating on the surface in shallow water (e.g. rock pools), particularly after storms.

6. Habitat Details

To date, the percentage of sightings by the applicable modes (*day diving, night diving, snorkelling, other means*) for which habitat has been specified, has ranged from 78 % in SA to 100 % in TAS This includes repeat sightings in the same habitats, and also several aggregate records and sightings of large groups of seadragons. In the SA 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. Within and between States, there appeared to be some lack of standardisation in the recording of bottom type and habitat details, and there were also many mixed habitats recorded, containing more than one of each of the main categories (e.g. *seaweed, reef, giant kelp, seagrass, sand* etc), and a number of *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: In each State, around 30 – 40 % of the sightings by the applicable modes reported *sand* in the category of *Habitat* or *More Details about Habitat* categories. 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 a few records listing only sand, with no cover specified. The majority of 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.

Seagrass: Related to the sand bottom habitat (as detailed above), is the relatively high incidence of records from *seagrass*-dominated habitats, or mixed habitats containing seagrass, which accounted for about 30 – 40 % of all sightings by the applicable modes in each State except Tasmania (see below). In **Victoria**, the percentage of sightings in seagrass habitat reflects the large number of dives at several popular locations where seagrass is present as part of a mixed habitat, e.g. Portsea Pier, Flinders Pier, and several sites off Queenscliff, Portarlington and Portland. At Flinders Pier, one diver (A. Raff, pers. comm. to Dragon Search, 2002), reported that seadragons were most numerous along the edges of sand and seagrass areas. The comparatively large number of records from specific locations favoured by Dragon Search reporters (such as Portsea and Flinders and sites off Queenscliff, in Victoria) can bias Statewide summary results of habitat data, in terms of percentage calculations. In **South Australia**, almost half of the records for which seagrass was specified in the cover, came from the Rapid Bay area, 8 % of records came from a jetty in western GSV and about 7% of seagrass habitat records were each reported from the Encounter Bay area, and a jetty in SW GSV. Other sites for which seagrass habitat was recorded include another jetty in south west GSV and Second Valley area (south-eastern GSV), and metropolitan locations such as the surrounds of patch reefs at Glenelg, and Seacliff Reef.

In **Western Australia**, almost 43 % of records for which seagrass was specified as a major cover came from the Bremer Bay area. Kelp, other seaweed, patch reefs, and other features were also present in various parts of these diving and snorkelling locations for which seagrass was specified. Almost 7 % of records with seagrass as a main cover, came from the Esperance area, 7 % came from around Fremantle, 6 % from around Rottnest Island (some of which also included reef patches with kelp and other seaweeds) and 5 % of records from Cottesloe (also including mixed habitats with reef patches and seaweed in addition to seagrass). A small number of Dragon Search records specified the genus of seagrass, and three genera were recorded: *Posidonia* (commonly known as tapeweed or ribbon weed), *Amphibolis* (wireweed) and *Halophila* (paddleweed). Because seagrass usually grows on sand, it is not surprising that about half of the seagrass records also specified sand in the *Habitat* category. A large number of habitat records in which seagrass was present, also contained seaweed (e.g. 28 % of the SA records). Other mixed habitats in which seagrass was present included those described as: seagrass/seaweed/rubble; seagrass/seaweed/reef; seagrass/reef, and seagrass/seaweed/reef. The reports for each State (e.g. Baker, 2002a, 2002c, 2002e; Howe, 2002; Baker 2005a, 2005b, 2005c) discuss in more detail the locations in which seagrass was specified as a main part of the cover.

In **Tasmania**, there was a low incidence (4 %) of weedy seadragon sightings over *seagrass* habitat, or mixed habitats containing seagrass. Seagrass was recorded at a site on the south-western side of Flinders island; a metropolitan dive site south of Hobart; Safety Cove (near Port Arthur); and three sites near Eaglehawk Neck (Tasman Peninsula). Four of the six locations in which seagrass was recorded, also contained other benthic features in the vicinity (e.g. giant kelp and other seaweeds such as *Ecklonia*, bare sand, boulders etc). It is noted that the majority of dive sites from which seadragons have been recorded in Tasmania are reef habitats, or mixed sand and reef patch habitats, often dominated by giant kelp and/or other seaweeds. Such seaweed-dominated habitats (e.g. the Kingston / Blackman's Bay area, and around Tasman Peninsula) are popular dive sites in Tasmania. Apart from the relatively low incidence of seagrass in Tasmania compared with other temperate locations in southern Australia, the popularity of kelp-dominated dive sites in Tasmania should be considered when interpreting the low incidence of weedy seadragon records in Tasmanian seagrass habitats. The comparatively large number of records from specific, kelp-dominated locations favoured by Dragon Search reporters, can bias statewide summary results of habitat data.

Seaweed and/or Reef: A large number of records of both weedies and leafies came from both *seaweed*-dominated and/or *reef*-dominated habitats. The table below lists the approximate percentage of sightings in each State, for which seaweed (excluding Giant Kelp) and / or reef (excluding artificial / tyre reefs) was specified as part of the main cover or as part of the other habitat details provided.

Table 6: Percentage (%) of sightings (approximated) in each State for which seaweed (excluding giant kelp) and / or reef were specified as part of the main cover

State	Percentage of sightings for which seaweed was specified	Percentage of sightings for which reef was specified	Percentage of sightings for which both seaweed & reef were specified
NSW	Weedy: 22	Weedy: 22	Weedy: 3
VIC	All: 27 Weedy: 30 Leafy: 11	All: 31 Weedy: 28 Leafy: 55	All: 5 Weedy: 5 Leafy: 5
SA	All: 54 Weedy: 44 Leafy: 58	All: 40 Weedy: 47 Leafy: 34	All: 29 Weedy: 24 Leafy: 31
TAS	Weedy: 24	Weedy: 26	Weedy: 1
WA	All: 33 Weedy: 31 Leafy: 36	All: 5 Weedy: 4 Leafy: 6	All: 1 Weedy: <1 Leafy: 2

The way in which habitat details were recorded, was not standardised between States, which may account for the larger percentage of sightings in SA for which both seaweed and reef were specified in a single category, compared with all other States. It is noteworthy that many of the dive sites for which seaweed cover was specified, are macroalgae - dominated reefs. Examples of such areas for which 'seaweed' was specified as the cover in the vicinity of the seadragon sighting, include the following:

- ***New South Wales***: Palm Beach, sites around Sydney area (South Head and North Head, Bondi, Maroubra, La Perouse, Kurnell, Cronulla), Wollongong, Jervis Bay, Shellharbour, Kiama, and Eden / Twofold Bay.

- ***Victoria***: Portsea, Rye, and Flinders a dive site off Point Lonsdale, reefs off Queenscliff, and sites in Portland Harbour.

- ***South Australia***: Flinders Island and Avoid Bay on the West Coast (the latter specifying low calcareous reef with *Ecklonia*); coastal reefs outside Coffin Bay on the Eyre Peninsula, islands in Thorny Passage off the lower Eyre Peninsula, reefs in the Gambier Island group at the bottom of Spencer Gulf, several reefs on the mid-northern coast of Kangaroo Island (at least one area dominated by a dense cover of mixed brown canopy macroalgae), a number of reefs in the Encounter Bay area (including island reefs), reefs at Second Valley, parts of the Rapid Bay Jetty area (*but see also section below on Rapid Bay*), two of the southern metropolitan reefs, several reefs off the mid-coast of the Fleurieu Peninsula, and reefs of various forms (including overhangs and bommies – a shallow isolated reef located a distance offshore) at a few locations in the lower south-east Additionally in SA, a number of sightings in the historical database came from abalone research surveys in various parts of the SA, 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).

- ***Western Australia***: sites are in Bremer Bay, various reefs in the Albany and Esperance areas, Rockingham; Mandurah, Garden, Carnac and Rottnest Islands., Fremantle, Perth area (e.g. Cottesloe, Marmion), and Mullaloo / Ocean Reef Harbour.

- ***Tasmania***: sites off Bicheno (north-east coast), Blackmans Bay, Kingston, Eaglehawk Neck, Port Arthur, and Fortescue Bay.

Kelp: Both weedy and leafy seadragons were recorded from habitats containing *kelp*. In southern Australia, kelp refers to plants in the marine plant order Laminariales, namely the Common Kelp *Ecklonia radiata*, and the Giant Kelp species *Macrocystis angustifolia* and *M. pyrifera*. **Table 7** shows the percentage of sightings, and the percentage of all seadragons sighted by the applicable modes, for which kelp was listed as the habitat type.

Table 7: Summary of seadragon sightings in each State for which kelp was specified as habitat

State	Percentage (%) of sightings for which kelp was specified	Percentage (%) of seadragons for which kelp was specified	Species present
NSW	16	10	• *Ecklonia radiata*
VIC	10	5	• *Macrocystis angustifolia* *Ecklonia radiata*
SA	6	12	• *Ecklonia radiate* *Macrocystis angustifolia* (lower south - east only)
TAS	36	28	• *Macrocystis pyrifera* (mid - east and south - east) *Macrocystis angustifolia* (mainly north and north - west)
WA	6	5	• *Ecklonia radiata*

- ***New South Wales***, only Common Kelp *Ecklonia radiata* occurs. Examples of locations in which this was specified in the habitat details include Eden (where an aggregation of 20 weedies was sighted at the edge of kelp habitat), Jervis Bay, Maroubra, Kurnell, La Perouse, Wollongong and Shellharbour.

- ***South Australia***, ***Victoria*** and ***Tasmania*** records included kelp-dominated habitat, but also habitat in which kelp was listed with other descriptors (e.g. other seaweed present, reef; seagrass, sand; rubble, and combinations of those). *Macrocystis* is a cool water genus, and only one of the two south-eastern Australian species occurs in SA, in the lower south-east. In SA, 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. *Macrocystis angustifolia* is also the Giant Kelp species that occurs in Victoria (see Womersley, 1987), and six records specified this type. However, as in SA, unspecified 'kelp' may also refer to *Ecklonia radiata.* Notably in Victoria, there were three records of leafy seadragons occurring in kelp habitat (representing three animals sighted). Most Victorian records, in which kelp was specified, came from Portsea and Queenscliff. In SA, examples of locations at which kelp was reported to be one of the dominant covers included the Bluff in Encounter Bay, sites at Second Valley, Seacliff Reef, Seaford

Reef, Western River Cove (Kangaroo Island), Chinaman's Hat Island (Yorke Peninsula), and North Island (Wedge Island group).

- ***Tasmania***, there was a high incidence of weedy seadragon recordings from habitats containing Giant Kelp (*Macrocystis*), which includes both kelp-dominated habitats and reefs where kelp was present with other seaweeds. In Tasmania, *M. pyrifera* is found on the mid east coast (e.g. Freycinet Peninsula) and commonly occurs on the south-east coast (e.g. bays on the Forestier and Tasman Peninsulas); *M. angustifolia* is found mainly on the north and north-west coasts. Some specimens from more sheltered northern and south-eastern Tasmanian localities display intermediate characters between the two species (Womersley, 1987). Giant kelp was recorded by Dragon Search divers in rock/reef, rubble and sand habitats, and combinations of these. For example, some records listed seadragons as occurring at 'interface' habitats of giant kelp in areas of boulders or rubble, near bare sand patches.

- ***Western Australia***, both weedy and leafy seadragon sightings came from habitats containing kelp, but these represented only 6% of all sightings for which habitat was specified. Around half of the sightings for which kelp was specified were from kelp-dominated habitat. The remainder were from mixed habitats, such as those containing kelp patches on reef adjacent to seagrass beds, or limestone reef with mixed seaweed including kelp. In WA, kelp would refer to Common Kelp *Ecklonia radiata*, because Giant Kelp does not occur in that State (Womersley, 1987). Sites in WA at which kelp was the dominant cover included several sites around Bremer Bay, reefs near Hopetoun; south side of Rottnest Island, a site south-west of Garden Island, a site near North Mole at Fremantle, and reefs near Hillary's Boat Harbour.

Rubble: **Table 8** lists the percentage of records for which habitat including a rubble feature was specified either as 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 these). In **Western Australia**, there have been 17 records that specified rubble as either the main bottom type or as part of a habitat of mixed features or other habitat type. In WA, rubble bottom was recorded at a site at: Bremer Bay, a site at Albany, Lucky Bay at Esperance, Cape Naturaliste, sites off Rockingham and Bunbury, sites off Fremantle, Garden Island and Carnac Island, Cottesloe, the Swan River, and Hamelin Bay. In **South Australia**, 92 records listed rubble, two thirds of which came from the Rapid Bay Jetty (an environment which also contains seagrass and macroalgae). Rubble bottom was also recorded at: Thistle Island (south - western Spencer Gulf), and in the vicinity of the jetties at Kleins Point, Port Giles, Wool Bay, and Edithburgh on the Yorke Peninsula, Kingscote Jetty on Kangaroo Island (where sand and mud were also recorded), various nearshore reefs in the Victor Harbor area, the dumping ground at Port Stanvac, Seacliff Reef and a site off Kingston Park in the metropolitan area, as well as a number of other locations. In the SA database, rubble was listed as part of the habitat in 22 % of the seagrass records, and approxiamtely 8 % of the seagrass records listed both sand and rubble/stones as part of the seagrass habitat. In Victoria, rubble was recorded as part of the habitat at the piers at Flinders and Portsea, and at a site near Point Lonsdale (where a group of 12 leafies was observed over sand near rubble reef). **Tasmanian** locations in which rubble was specified included sites at Eaglehawk Neck, Kingston, and South Arm, amongst others. **In New South Wales**, habitats in which weedy seadragons were sighted in rubble included Kurnell (where sand was usually listed as well), La Perouse, and sites in Jervis Bay, amongst others.

Table 8: Summary of seadragon sightings in each State, for which rubble was specified as habitat

State	Percentage (%) of sightings for which rubble was specified
NSW	9
VIC	6
SA	19
TAS	9
WA	3

Sponge: In **New South Wales**, 13 records came from habitats in which 'sponges' or 'sponge gardens' was specified as the main habitat type, and another 12 records included sponges as a major part of the reef habitat description. Such locations included a site off North Head, Bare Island off La Perouse, Bundeena, and sites in the Tathra area. In **South Australia**, sponge beds are not common in dive-able locations or depths. In Victoria, there was one record of three adult weedies observed near pier struts, amongst sponges and seaweed. Two records from **Western Australia**. specified habitat containing sponges, one of which was described as a 'sponge wall' in Bremer Bay, where one weedy seadragon was observed.

Other Habitat: was specified for around 5 – 6% of sightings in each State, and was also included with one of the main habitat descriptors (sand, seaweed, seagrass, rubble etc) for an additional 8% of South Australian records. Examples of habitats for which *Other Habitat* was specifically recorded included jetty pylons / struts, a variety of nearshore rocky habitats (shallow rock pools, boulders, a rock outcrop on gravel bottom, recesses in rock; and 'broken bottom' – the latter of which likely refers to calcareous reef), various artificial habitats (car tyre reefs, a car body wreck), a scallop bed, and 'jetty rubbish'. In **Victoria**, one diver (A. Raff, pers. comm. to Dragon Search, 2002) provided details of the large amount of rubbish littering one of the popular jetties for diving, this included plastics, bottles, steel, batteries and numerous other items, cleaned shellfish and other fished species, as well as fishing line and associated fishing gear. The diver reported that there is a large amount of human traffic at this site, because it is popular for fishing, boating and diving.

Mud: A small number of records specified mud habitat, as part of a mixed habitat with other benthic cover (e.g. mud, sand and rubble at a jetty on north-eastern Kangaroo Island in SA Mud / silt, sand and seagrass at Portarlington in Victoria, as well as mud, seagrass, rubble and seaweed at Portsea Pier in Victoria).

In **Victoria** and **South Australia**, a small number of divers provided quite specific habitat details for the areas in which they dive regularly. One example is the habitat at a site off Point Lonsdale, where a snorkel diver has observed seadragons for about 10 years. The diver reported that seadragons often hover at the edge of gutters and overhangs, close to sandy bottom. The diver reported seeing the seadragons further offshore in deeper water during rough weather, when a lot of (drift) kelp and other seaweed collected further inshore in the habitat where the seadragons are usually seen.

7. Behaviour

For each State, 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. Notes about the recorded behaviours are provided below the table.

Table 9: Summary of main behaviours observed as percentage (%)number of seadragons for which behaviour was recorded

Main behaviour observed	Percentage of seadragons for which behaviour was recorded				
	NSW	VIC	SA	TAS	WA
Hovering	63	43	48	42	49
Hovering / Swimming	4	30	17	8	8
Swimming	26	12	13	22	5
Resting	< 1	-	-	11	2
Other	< 1	< 1	10	1	5
Feeding	5	4	6	7	13
Feeding / Swimming	-	2	2	-	< 1
Feeding / Swimming / Hovering	-	5	<1	4	-
Feeding / Hovering	1	-	1	5	-
Reproduction / 'Egg Transfer'	-	1 record	1 record	-	-
'Nursing'	-	1	< 1	-	-

- ***New South Wales***, *feeding* was observed mainly at the edge of kelp beds (other edges of reefs with other macroalgae), and also in one area described as a 'sponge garden' (off Tathra). *Courting* was observed at a reef in the Cronulla area in 1998 and at Malabar in 2001. At a reef in the South Head area (2001), a female weedy, and a brooding male weedy with well - developed, late stage eggs, were observed hiding amongst the fronds of a kelp plant. There were also several other records of weedies hiding in kelp plants. Other notable behaviour listed in the NSW database included (i) 'harassment' of a male seadragon by groups of wrasse at a reef near Manly in 2001, (ii) a weedy at Kurnell (1999) trying to maintain position on the sea floor, to avoid being swept out by the outgoing tide and (iii) a female weedy at Jervis Bay (in 2000) swimming close to the mouth of a Port Jackson shark.

- ***Victoria***, the few instances of *feeding* that were noted, occurred mainly in seagrass habitat in the vicinity of jetties (called piers in Victoria). Many of the records which described *swimming* and/or *hovering* were in the vicinity of piers, from where the majority of Victoria Dragon search records came. *Egg transfer* was reported in only one record, from under Portsea Pier.

- ***South Australia***, for both species, feeding was observed in both seaweed-dominated habitats (such as macroalgal-covered reefs) and seagrass habitats (e.g. *Posidonia* beds; *Amphibolis* beds). Groups of weedies and single weedy 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, as well as 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 two 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 four 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, two out of three egg-bearing male weedies 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 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, and swimming).

- ***Western Australia***, *feeding* was observed in both seaweed-dominated habitats (such as macroalgal-covered limestone reefs) and seagrass habitats (e.g. *Posidonia* beds and mixed *Posidonia* - *Amphibolis* beds). There were also several records of feeding observed in mixed reef and seagrass habitats, and at a jetty pylon habitat. Two brood male weedy seadragons were reported to be *nursing* (one of which had half of the attached eggs hatched), and there was one record of two weedies observed courting. The purported incidence of *defending* (17 % of seadragons sighted, equivalent to about 90 records) is not recorded in the table above, because it is possible that the code for this behaviour ('D', which is no longer used in the Dragon Search program), was misinterpreted as 'drifting' in the majority of cases; *drifting* was recorded in the behaviour details section for many of those records for which 'D' was the behaviour code. However, nine of the records of *defending* behaviour referred to brood male seadragons with eggs, and it is therefore possible that *defensive* behaviour by the seadragons was observed in such cases. There were eight records of other behaviour, mostly unspecified, but also including an adult weedy "swimming fast along sandy bottom, and then up over reef" at a site in Marmion Marine Park, two adult weedies sheltering undercover from the swell at Back Beach in Bremer Bay, three weedies and one leafy hiding behind seaweed, in a cave at a site off Cape le Grande National Park, and a record from Lucky Bay in which five weedies were sighted drifting in the vicinity of one leafy, which was stationary on the bottom.

- ***Tasmania***, *feeding* was observed in beds of kelp and cray weed, and at the edge of reefs, including bommies and rock walls.

8. Seadragon Groups

Repeat Sightings: In each State, groups of seadragons 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. Examples of repeat sightings are listed in the Dragon Search database reports for WA (Baker, 2002c), South Australia (Baker, 2005b) and Victoria (Baker, 2005c).

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 State databases, which indicates the ongoing importance over time of such areas as habitat for "resident" groups of seadragons. Some examples include:

- ***New South Wales***: (i) groups of four – 17 weedies were recorded at a site near Kurnell, from 2000 to 2002, and groups of three to 22 were recorded at another site in that area, between 2000 and 2003, (ii) groups of four to eight were recorded at an island in the La Peruse area, between 1996 and 2000, (iii) pairs and groups (up to 10) were observed at one site in Jervis Bay, between 1999 and 2002, and groups (up to six) were observed at another site in that bay, every year from 1997 to 2000.

- ***Victoria***: groups of weedies (15 - 40) recorded at Flinders Pier from 2000 to 2004, (ii) groups of weedies (3 – 12 individuals) observed at Portsea, from 1999 to 2005, (iii) a groups of five weedies observed at Rye in 2001, and a group of 19 observed there in 2003, and (iv) pairs of weedies observed at a site near Queenscliff, from 1997 to 2003.

- ***South Australia***: (i) a group of three weedies observed at Avoid Bay in 1996, and several sightings of groups in January 1999 (3, 4, 4 and 11 weedies), (ii) pairs or small groups of leafies observed at a jetty in western GSV (GSV) in 1997, 2001 and 2002, a large group of leafies (13 animals) observed at a jetty in south-western GSV in 1994, and a small group (four animals, including a juvenile) and a pair observed there in 2000; (iii) groups of weedies observed at an artificial reef in GSV in 1997 (two sightings, of two animals and 11 animals), 1998 (eight animals), and 2001 (three animals); (iv) pairs of weedies observed at another artificial reef in 1995, 1997, 1998 and 2001; pairs and/or small groups of weedies or leafies recorded from a reef in southern metropolitan GSV, in most years between 1992 and 2003 (rarely with both species recorded together); (v) singles, pairs and groups of weedies (with groups ranging from three to 20 animals) and leafies (groups of three to 16 animals), regularly observed at Rapid Bay: there are groups of both species recorded for most years between 1996 and 2005. Other examples are provided in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

- ***Tasmania***: (i) groups of weedies ranging from three to 20 individuals, recorded at Kingston Beach, between 1997 and 2001, (ii) pairs observed at Deep Glen Bay in 1996 and 1999, (iii) groups ranging from 3 to 16, at Blackman's Bay, between 1998 and 2000, (iv) small groups (up to four individuals) observed at a site in Port Arthur, between 1997 and 2002, and (v) small groups (up to four individuals) observed at South Arm, 1997 – 1999.

- ***Western Australia:*** (i) groups of 2 - 10 weedies recorded at a site in Bremer Bay, between 1998 and 2000, and other groups recorded at two other Bremer Bay sites, between 1998/1999 and 2002; (ii) small groups (2 - 5) of weedies recorded at a site near Fremantle in 1993, 1994, 2000 and 2002.

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 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 work by Connolly et al. (2002) on leafy seadragon abundance and movement at West Island in Encounter Bay (South Australia) showed that approximately nine 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 35 m – 82 m), although there was some movement of animals out of the study area (a 100 m 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 dived regularly at Encounter Bay and at a site on the Dudley Peninsula on north-eastern 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).

Table 10 lists the five largest groups of seadragons recorded in the Dragon Search database for each State. In ***Western Australia***, the most outstanding example of a group of weedies is a sighting in 1993 by a snorkeler, of approximately 120 individuals near a groyne in the Cottesloe area. In addition to the sightings listed below, three groups of 10 weedies were recorded, at Albany and Bremer Bay. Two groups of six leafies were also recorded at Albany and Garden Island. In ***South Australia***, aggregations of both weedy and leafy seadragons were recorded at Rapid Bay during the 1990s and 2000s. Other locations where seadragon groups were reported include a site off Noarlunga (lower metropolitan area), a site in Encounter Bay and one off Blackfellows Caves (in south-eastern SA). In ***Tasmania***, aggregations have been recorded at locations in both the south (e.g. Blackman's Bay) and the north (e.g. Woolnorth Point) of the State. In ***Victoria***, repeat sightings of large groups of weedies (ranging from 15 - 40 individuals) were made at Flinders Pier in 2002; groups of 10 and 11 were recorded there in 2003, and another group of 20 was recorded in that area in 2004. In ***New South Wales***, repeat sightings of large groups were made at Kurnell, mainly between 2000 and 2002. Other groups were recorded in the La Perouse area (2001), Wollongong (1999), and Eden (2001). Two sightings of 10 individuals were made at a site in Jervis Bay, in 2000 and 2001.

Table 10: The five largest groups of seadragons recorded in the Dragon Search database for each State, W = weedies, L = leafies

No. of seadragons per group (including repeat sightings)	**Marker**	**Type**	**State**
125	Cottesloe area	W	WA
12	Bremer Bay	W	WA
12	Esperance	W	WA
11	Cape Leeuwin	W	WA
8	Mullaloo	L	WA
20 (18 were juveniles), 16 (12 were juveniles), 12 (2 records)	Rapid Bay Jetty	W	SA
12	Port Noarlunga	W	SA
12	Blackfellow's Caves	W	SA
16, 9, 8, 7	Rapid Bay Jetty	L	SA
12	Encounter Bay	L	SA
40, 30, 25, 20, 15	Flinders	W	VIC
19	Rye	W	VIC
12	Portsea	W	VIC
12	Point Lonsdale	L	VIC
11	Flinders	L	VIC
20	Kingston Beach	W	TAS
19	Kingston Beach	W	TAS
16	Blackman's Bay	W	TAS
13	Bicheno	W	TAS
13	Woolnorth Point	W	TAS
38, 35, 22, 21, 20, 18, 17, 16, 11	Kurnell	W	NSW
35	La Perouse area	W	NSW
20	Wollongong	W	NSW
20	Eden	W	NSW
10	Jervis Bay	W	NSW

There are examples where some of the records represent repeat sightings of the animal(s), or the same members of loosely structured groups, recorded either during the same day or in the case of some groups, within a few days of the previous dive. These are detailed in the various State reports.

9. Brooding Male Seadragons

Figure 3 summarises the number of sightings reported to date, of brooding male weedies and leafies, for each State. **Maps 3a, 3b, 3c, 3d** in **Appendix 1** summarise the distribution of brood male weedies and leafies sighted in each bioregion of the southern Australian States, to mid - 2005. **Table 11** summarises the number of records of brood males recorded in each state, to 2005.

Table 11: Summary of records of brooding male seadragons in each State

State	Number of records of brooding male weedies (W) and leafies (L)
NSW	86 (W)
VIC	15 (W)
SA	30 (W), 47 (L)
TAS	26 (W)
WA	73 (W), 23 (L)

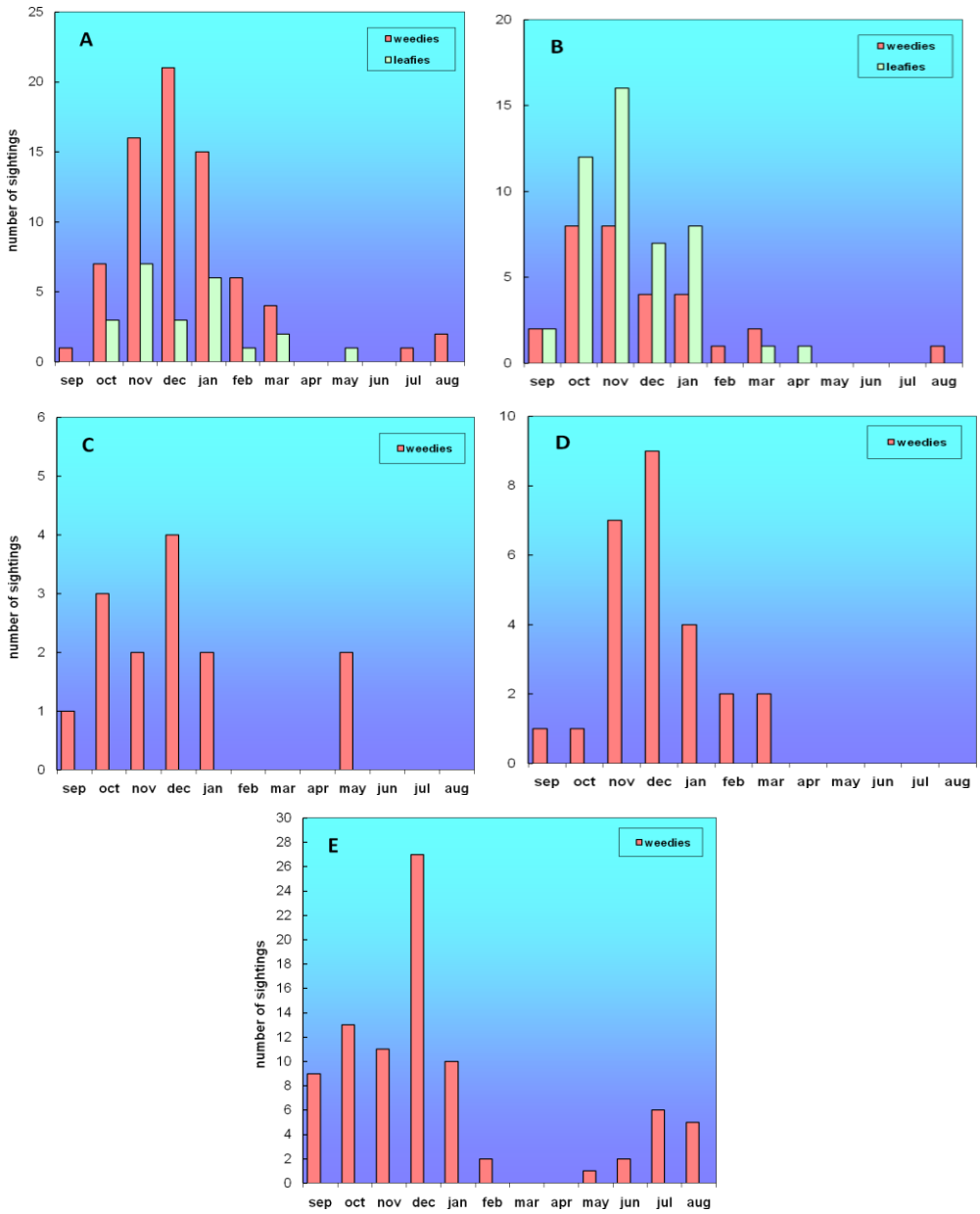


Figure 3: Monthly summary of brooding male weedy and leafy seadragon sightings. A = WA; B = SA; C = VIC; D = TAS; E = NSW (N.B. locations and years combined, 1990 - 2005)

Table 12: Summary of seasonal distribution of sightings of brood male seadragons in each State, W = weedies, L = leafies.

State	Time period	Seasonal percentage (%) of total sightings of brooding males							
		Spring		Summer		Autumn		Winter	
		W	L	W	L	W	L	W	L
NSW	Jan 1990 - Jun 2005	39	-	35	-	1	-	15	-
VIC	Jun 1995 - Apr 2005	40*	-	40*	-	13*	-	0*	-
SA	Jan 1990 - May 2005	60	64	30	32	6	4	3	0
TAS	Apr 1990 - Apr 2005	35	-	58	-	7	-	0	-
WA	Jul 1990 - Apr 2005	33	46	58	42	5	12	4	0

*****(Victorian statistics do not add to 100 % because month was unknown for 7 % of records of brood males).

In ***New South Wales***, researchers have recorded seadragons breeding from June to January, with a peak in November - December (e.g. Sanchez-Camara et al., 2005). Despite the opportunistic nature of Dragon Search reports, the seasonal distribution of brood males recorded by divers in that program over the period 1990 – 2005 corresponds with the aforementioned research results; i.e. breeding commencing in winter, and continuing throughout spring and summer, with a peak in January. In the Dragon Search database, there are only two records of brood males sighted in June (out of approximately 40 dive records for that month, with years combined), and 10 records to date of brood male weedies in January. To date, there are two Dragon Search records of brood males being observed in February. Researchers have observed males becoming pregnant twice in the one year, with an approximate two month gap between the pregnancies (Sanchez-Camara et al., 2005). Males may move into shallower water to release the young. Weedy seadragons in New South Wales may breed over a longer period throughout the year compared with those in cooler waters further south. For example, there are winter and early spring records of brood males in New South Wales, but no winter breeding records in Victoria or Tasmania, for any year of the Dragon Search program.

In ***Victoria,*** there were only 15 records of breeding male weedies, and no records of breeding leafies. For weedies, 80 % of the records of brood males were in the spring and summer months. Notable records include a report of 25 brood male weedies seen at one of the jetties in Port Phillip Bay in December 2000. Most of the groups of brood males have been observed in the vicinity of jetties, but there are two records from western Victoria (five brood males recorded in the Portland area, October 1999 and twoin the Warrnambool area, September 1997).

In ***South Australia***, with data pooled for all years between 1990 and 2005, brooding male weedies have been recorded mainly between mid - spring (October) and mid - summer (January), accounting for around 80 % of the 30 records. There are also two records from mid-late September, two records from early-mid March, one 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 three records of pairs (two pairs of which were brooding males sighted amongst a group of seadragons), and one record of three brood males sighted together within a larger group (see section on **Groups of Brood Males**). At a Statewide scale, brooding male weedies have been recorded, to date, at depths ranging from 3 m to 20 m, 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 a southern metropolitan reef in January). In

SA, there have been 47 records of brood male leafies to date, representing a total of 77 individuals (data pooled for the period 1990 - 2005). As with weedies, the greatest numbers of brood male sightings (43 of the 47) were 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 each from March and April, but there have been no winter recordings to date. Thirty four of the records were of single brood leafies, and a number of pairs were also observed (seven records). Groups of brood male leafies are discussed in a separate section below. Brooding male leafies have been reported at depths ranging from 3 m to 15 m, and in waters ranging from 13 ^{o}C (western GSV, in April 2004) to 21 ^{o}C (Rapid Bay in December 1999 and January 2000).

In ***South Australia***, 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**. Despite the small number of records of brooding seadragons available per year, 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) 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 GSV Bioregion: (i) two brood leafies and two brood weedies observed at a central northern Kangaroo Island cove in March 2001; (ii) one brood weedy observed at Rapid Bay in the first week of March 2002 and (iii) three brood leafies observed during April 2004 at a jetty on in western GSV.

In ***Tasmania***, the majority of the 26 records of brooding male weedies have been reported between November and January. Half of the records of brood males came from sites along the Tasman Peninsula, such as the Port Arthur and Eaglehawk Neck area. Several records, including small groups (3 - 4) of brood males were also recorded in the Blackman's Bay area. There were several records from northern (Woolnorth) and north-eastern (St Helens, Bicheno) Tasmania.

In ***Western Australia***, the majority of reports of brooding weedies and brooding leafies were from November to January. About two thirds of the reports of brooding male weedies came from Bremer Bay, with other locations including Albany, Esperance, Dunsborough, Fremantle and beaches in the Perth area. Notable sightings included a group of 6 brooding male weedies at Bremer Bay in November 1999, five brooding male weedies in the Esperance in December 1999; four brood male weedies recorded off a metropolitan beach in November 2003, and groups of three or four brood males at Bremer Bay (1999-2001). Depths for brood male weedy sightings range between 2 and 22 m, with water temperatures between 16 and 23 ^{o}C. For brood male leafies, recorded depth ranged between 1 and 19 m, and temperature ranged between 16 and 25 ^{o}C. More than half of the reports of brooding male leafies came from Bremer Bay, with other locations including Albany, Fremantle and Rottnest Island.

Notes on Winter and Early Spring Breeding: In **South Australia**, the only record of brood male seadragons observed in winter was a record of two beachwash specimens from Encounter Bay, 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 SA 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. In **Western Australia**, two of the 73 records of brooding male weedies were reported in August, and one in July. One of these was an unverified record of an unknown number of brood males amongst 20 weedies caught in purse seine net bycatch in the Albany area; another was a dive record from the Yanchep area in 2003 and the third was a beachwash record from the Perth area.

In **South Australia**, 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 GSV Bioregion and the GSV / Coorong boundary area:

- a brood male weedy at an island in Encounter Bay in late September 1993
- a brood male weedy in the Seacliff – Marino area area, in mid-September 2000
- a brood leafy at Kingston Park (north of Marino, in the metro area) in late September 1998 and
- five brood male leafies sighted during a dive in western Encounter Bay in late September 2002.

Brooding Males - Bioregions: In ***New South Wales***, 73 % of records of brooding males have come from locations in the Hawkesbury Shelf (HAW) bioregion, reflecting the popularity of several dive sites in the region such as those at North Head, South Head, La Perouse and Kurnell, the latter in particular. About 22 % of records of brooding males have come from the Bateman's Shelf (BAT) bioregion (mainly from popular dive sites in Jervis Bay), and nearly 5 % of records have come from the Twofold Shelf (TWO) bioregion (Eden and Tathra).

In ***Victoria***, 12 of the 15 records of brooding male weedy seadragons (to April 2005) have come from sites in the Victorian Embayments (VES) Bioregion, and three have been recorded at sites in the Otway Bioregion. Records from the VES Bioregion include 5 from Portsea area, five from the Flinders area, and one from a reef off Queenscliff. In the OTW Bioregion, reports of brooding males have come from sites off Portland (two records), and Warrnambool.

In ***South Australia***, for both species combined, about 84 % of records of brooding male seadragons have come from the Gulf St Vincent (GSV) bioregion, particularly from popular dive sites such as Rapid Bay, and reefs in Encounter Bay. Around 76% of the records of brooding male weedy seadragons have come from sites in the GSV Bioregion, particularly from reefs in the Encounter Bay region between 1992 and 2000 (accounting for about half of the GSV Bioregion records of brood male weedies). Within the Eyre Bioregion, three sightings of brooding male weedies have been reported, all during spring months (October and November), these being records from an island in the Investigator Group in 1998; the Elliston area 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 at a site south of Robe in January (year unrecorded). There has been one record to date from the Coorong (COR) Bioregion,

a beachwash report from Goolwa in October 1997. Similar to the reports of brood weedies, most SA records of brooding male leafy seadragons have come from the GSV Bioregion (about 89 % of the records of brooding leafies, to date). Thirty of the 42 GSV 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 GSV Bioregion in which brood male leafies have been recorded include Encounter Bay (four reports), two sites on northern and north-eastern Kangaroo Island, two metropolitan reefs (two records), a reef off Fleurieu Peninsula (one record) and two jetty locations in south-eastern GSV / south-western Yorke Peninsula (three records). Within the Eyre Bioregion (EYR), brood male leafies have been reported in the vicinity of two islands in Thorny Passage (four records collectively, from 1995, 1997 and 2000). There is also a report from an island in the Gambier Group (November 1995), south of Spencer Gulf.

In ***Tasmania***, 61 % of the 26 records of brood male weedies have come from the Bruny (BRU) bioregion (e.g. Blackman's Bay, South Arm, Eaglehawk Neck and Port Arthur), with several records from the Freycinet (FRT) bioregion (e.g. Eddystone Point, St Helen's, Bicheno) and a couple from the Boags (BGS) bioregion (Woolnorth Point area).

In ***Western Australia***, about 80 % of the records of brood male weedies and 70 % of the records of brood male leafies came from the WA South Coast (WSC) Bioregion (e.g. Bremer Bay, Albany and Esperance), with the remainder from the Leeuwin – Naturaliste Bioregion (LNE) bioregion, the latter including Perth, Fremantle, Garden Island, Rottnest Island, Yanchep and Dunsborough.

Groups and Pairs of Brood Male Weedy Seadragons: In ***Western Australia***, a group of six male weedy seadragons with eggs was observed underwater at Bremer Bay in November 1999, a group of five brooding male weedies was observed at Lucky Bay (Esperance) in December 1999, four brooding weedies were caught in a purse seine net off City Beach in January 1989 (pre-Dragon Search), and another record of four brooding males came from Bremer Bay in November 2001. To date, there are five records of three brood males, one of these from Two People's Bay (November 1998), and the rest from Bremer Bay (November 1999, February 2000, December 2000 and October 2001). Twelve records of pairs of brooding male weedies have come from sites around Bremer Bay, and one pair was reported from a site off Albany (December 2000). Additionally, there is an aggregate record referring to several snorkelling trips off the metropolitan beach area, in 1993. Although the total number of brood males was not specified, the recorder (who was a licensed collector at the time) reported that often up to 20 weedy seadragons of various sizes were seen in a one to two hour period, while the recorder was swimming 50 m offshore, and that the seadragons were frequently either gravid females, or were males with eggs attached to tail. The recorder also stated that males were often observed carrying eggs during the early summer period (see **Seadragon Groups and Singles** section). No groups of leafies have been reported to date in the Dragon Search WA database. Except for the record of a pair of brood male leafies observed at Mandurah in November 1998, all other records of brood leafies have been of single animals.

In the ***South Australian*** database to date, there has been only one record of more than two brood male weedy seadragons sighted together, from a reef in Encounter Bay, in October 1998. The report stated that two of the three brood males were swimming together, and each brood male had around 65 – 80 eggs attached. During that dive, six 6 non - brooding seadragons were also observed. There are three records of pairs of brood male weedy seadragons. One

of these records reported the two brood male weedies as being part of a larger group of seadragons. For leafies, the most brood males recorded during one sighting came from a popular diving site in Encounter Bay in October 1991, when at least six 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 five brood males have been reported from a seaweed habitat in Encounter Bay, in late September and early October of 2002; however these two records may refer to the same group of animals. A group of five 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 three brood male leafies with one non - brooding leafy was observed at an island in the Gambier group, at the bottom of Spencer Gulf, in November 1995. A group of three brood male leafies was also observed at one of the jetties in south - western GSV (Yorke Peninsula) in April 2004. Pairs of brood male leafies were mostly recorded from Rapid Bay Jetty during late spring to mid summer (six records, between November 1999 and November 2001), and one record of a pair of brood male leafies came from a site on the north coast of Kangaroo Island in March 2001. The SA Dragon Search database report (Baker, 2005b) discusses sightings of single brood male leafies (34 records).

In ***Victoria***, groups of male weedy seadragons with eggs have been observed underwater at Flinders Pier on the following dates, in descending order of number of brood males sighted: December 2000 (a record of 25 brooding males), November 2002 (six brooding males) and December 1997 (five brooding males). The recording of a 'mass' grouping of brood males, such as that recorded at Flinders Pier in December 2000, has been observed infrequently by recorders during the past decade of the Dragon Search Program in southern Australian States, and, if verifiable, is considered significant. Two other small groups of brood male weedies have been observed at: a reef off Portland (five brood males recorded in October 1999), and a site off Point Lonsdale (three brood males, recorded in January 2005). A pair of brood males was observed at Portsea Pier in 2002 (date unknown), and a pair of brood males was observed in a kelp bed off Warrnambool in September 1997.

Weedy Brood and Leafy Brood Males Sighted Together: Three of the ***South Australian*** records have noted both weedy and leafy brood male seadragons together. In one of these sightings, two brood leafies and two brood weedies were seen at a site on the mid - northern Kangaroo Island coast, in March 2001, and six non-brooding leafies and eight non - brooding weedies were also observed. There have been two 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 six weedies and three leafies were observed during the other Rapid Bay sighting in which brood males of both species were recorded.

10. Juvenile Seadragons

Table 13 summarises the seasonal sightings of juvenile weedy and leafy seadragons in each State.
In ***New South Wales***, there were 94 sightings of juvenile seadragons, to June 2005. Approximately 63 % of the sightings were made in the summer and autumn months. This corresponds with the late spring to early winter period in which researchers have also observed juvenile seadragons (e.g. Sanchez-Camara et al., 2005). One third of the records of juvenile seadragons were from the Kurnell and La Perouse areas. Sightings of groups of juveniles came from Kurnell (25 juveniles in a single report from June 2003 with about 15 adults), Swansea (17 juveniles observed in Match 2000) and Kiama (10 juveniles observed in December 2000). Approximately two thirds of all observations of juvenile seadragons have comprised a single animal. Approximately 78 % of all sightings of juveniles came from the

Hawkesbury bioregion which contains a number of popular diving spots. The report by Baker (2000a) discusses in more detail the sightings of juvenile seadragons in NSW during the first decade of records.

In ***Victoria***, juvenile weedies have apparently been recorded throughout most of the year, although to date, there are no records from July or January in the database. Thirty - two records of juvenile weedies have been reported, and 6 records of juvenile leafies. For weedies, the greatest number of monthly records include March (10 records), April (five records), and October and November (three records in each month). The largest total numbers of juvenile weedy seadragons recorded per month were in March (a total of 15 weedies), April (11 weedies) and February (nine weedies), however it is noted that such tallies are influenced by sightings of groups of juveniles. Given the season of breeding (mainly spring – summer period), it is surprising that juvenile seadragons have been observed during 10 months of the year (see data caveats below). The largest number of juvenile weedies observed in a single sighting came from Queenscliff, where seven juveniles and seven adults were recorded in May 1998. Other aggregations of juveniles have come from Portsea in February 2002 (five juveniles), April 2002 (four juveniles, with three adults) and April 2005 (four juveniles and eight adults), Flinders (a group of four juveniles and seven adults recorded in February 2001), Rye in March 2003 (a large group of four juveniles and 15 adults), and Portarlington in September 1997 (three juveniles and six adults). Records of juvenile weedies are discussed in more detail in the Victorian report. To April 2005, there were six sightings of juvenile leafy seadragons. Two of those records were of juvenile and adult leafies observed together (i.e. two juveniles with three adults observed at Flinders in February 2001, and one juvenile observed with two adults at St Leonards during the same month and year). Single juvenile leafies were recorded at Portsea (September 1997), Queenscliff (December 1997), Portland (June 1995) and Port Fairy (May 1997). There appears to be a peak in autumn in the observations of juveniles, but no other conclusions can be drawn, due to the small number of records (n = 38 for the whole of Victoria with years and locations combined), amongst other factors, including those that relate to recording. A size of less than 20 cm 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, which might explain the lack of seasonality of the juvenile sightings. Furthermore, more Dragon Search dives are taken in summer and autumn (when sea conditions are more pleasant) and vice versa in winter and spring, which can bias the results. Juvenile seadragons have been observed in the major habitat types (reefs; seaweed/algae, including some reports of giant kelp; seagrass; sand; rubble; and mixtures thereof), and engaged in the commonly-observed activities (hovering / resting, swimming, and feeding).

In ***South Australia***, 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. Some of the locations where juvenile weedies have been recorded include Rapid Bay, Second Valley and Edithburgh. Examples of locations where juvenile leafies have been observed include a site in Encounter Bay, Rapid Bay, three jetties in western and southern GSV, Seacliff in the metro area, a bay on southern Yorke Peninsula, and a headland site on north - eastern Kangaroo Island. 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 during a two month period in 2001 at one site in Encounter Bay where juvenile leafies were observed, (ii) repeated diving during the summer of 1997-98 at a 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). Sightings of juveniles are discussed in more detail in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

In ***Tasmania***, sightings of juveniles were made throughout the year, but with more in summer (30%), than in other seasons (19%). To April 2005, juvenile weedies have apparently been recorded during all months except April. Thirty seven records of juveniles have been reported, and the largest numbers of monthly records include January (eight records), August (five records) and May (four records), although the months differ for the largest total numbers of juvenile seadragons recorded, with a total of 16 juvenile animals being observed in November, 11 each in September and August, 10 each in January and June. Given the season of breeding (spring – summer period), it is surprising that juvenile seadragons have been observed during 11 months of the year (see data caveats below). Juvenile weedies have been observed in all habitat types (giant kelp beds, both seaweed- and animal - dominated reefs, seagrass, sand, rubble, and mixtures thereof), and engaged in the commonly-observed activities (hovering / resting, swimming, feeding). The reports by Baker (2002e) and Woodfield (2003) summarise the geographical distribution of juvenile weedy seadragon sightings to June 2002.

In ***Western Australia***, juvenile weedy seadragons have been observed in all months, with a peak during the summer months (38% of all records of juvenile weedies). Approximately 25 % of records of juvenile seadragons were in the spring months, and 21% in autumn. Sightings came from locations such as Bremer Bay (the majority of sightings of juveniles), Albany, Fremantle and sites around the Perth metropolitan area. In Bremer Bay, there were several records of small groups (e.g. three or four individuals) of weedy seadragons. In WA, there were few records (22) of leafy juveniles, and most were observed during summer (55 % of records) and autumn. Of note is a pre - 1990 record of a group of 50 juvenile leafy seadragons from the Fremantle area. Records of juvenile seadragons in WA are discussed in more detail in the report by Baker (2002c).

For both species, and in all States, it is difficult to use the 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 20 cm is stated by the Dragon Search Program as a guide to identifying juvenile seadragons. However, some of the records may be of small or young adults, and some might include misjudgements 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 (i.e. the program was not designed to include a set number of dives per month in a set number of locations), means that available data cannot be unequivocally used to determine the season in which juveniles are most prevalent in each State.

However, it would be expected that if the main breeding period is late spring to early summer (see above, and Kuiter, 2000), then small juveniles would be prevalent from early summer to at least autumn (e.g. following the five to eight week incubation period of males). Data for some of the southern States supports this with 42 % and 53 % of the sightings of juveniles being made during the autumn months in SA and VIC, respectively. 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[2], and at least one year to reach maturity (Kuiter, 2000) and (b) although weedies grow quickly, they do not reach adult size till over 12 months of age (Kuiter, 2000). 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.

Table 13: Seasonal summary of sightings of juvenile seadragons in each State, W = weedies, L = leafies

State	**Time period**	**Seasonal percentage (%) of total sightings of juveniles** (i.e. proportion of total number of juvenile seadragons sighted)							
		Spring		**Summer**		**Autumn**		**Winter**	
		W	L	**W**	L	**W**	L	**W**	L
NSW	Jan 1990 - Jun 2005	**14**	-	**32**	-	**31**	-	**23**	-
VIC*	Jun 1995 - Apr 2005	**25**	-	**12**	-	**53**	-	**10**	-
SA	Jan 1990 - May 2005	**13**	12	**37**	39	**42**	22	**8**	27
TAS	Apr 1990 - Apr 2005	**19**	-	**30**	-	**19**	-	**19**	-
WA	Jul 1990 - Apr 2005	**24**	0	**39**	55	**21**	41	**16**	4

*(Seasonal percentage of juvenile leafy sightings is not provided for Victoria due to low numbers of sightings)

11. 'Beachwash' Seadragons

Maps 4a, 4b, 4c, and **4d** in **Appendix 1** summarise the distribution of sightings of beached seadragons in the southern Australian States, to May 2005. Summaries for each State are provided below:

In ***Western Australia***, there have been 126 beachwash records to April 2005, comprising 156 seadragons. It is evident from the close correspondence between the number of records and number of seadragons that most wash - ups were of single animals, with notable exceptions being six weedies washed up at a beach in Hopetoun in 2005, five at a beach in Bremer Bay in 2000, and four at another beach in Bremer Bay in 1999. About 38 % of all beachcombing sightings to date were recorded during the summer months, 23 % during spring, 23 % during autumn, and the remainder during the winter months. Almost 60 % of the sightings to date have been of fresh seadragons and 40 % refer to old specimens. Five sightings of live beached seadragon have been recorded to date, two from Augusta (one of these from the mouth of the Blackwood River) and Dunsborough foreshore in the LNE bioregion; Billy Goat Bay near Geraldton in the CWC bioregion, and Wylie Bay, Esperance, in the WA South Coast bioregion. All of these records referred to single specimens sighted. Almost all of the sightings to date have been recorded between 1998 and 2002, although there are seven records from earlier years (1990 to 1997) and six records from 2003 to 2005. No 'mass seadragon mortality' events have been recorded in the Western Australian Dragon Search database.

Beachwashed seadragons have been recorded from more than 80 locations along the Western Australia coast. The tables in the WA report (http://www.reefwatch.asn.au/PDF/DragonSearch_WA_Sept2002.pdf) show some of the main locations in each bioregion where beachwashed specimens have been recorded. Within the WSC Bioregion, around

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

34 % of the beachwash sightings from that bioregion have come from beaches around Bremer Bay, and 22 % from sites near Esperance. Within the LNE Bioregion, around 27 % of the beachwash sightings have come from sites near Rockingham, such as Warnbro Beach, and 17 % have come from beaches in the Perth area. Within the CWC Bioregion, around 30% of the beachwash sightings have come from sites near Hillary's Boat Harbour, a popular recreation and tourism area north of Perth. Around 22 % of CWC beachwash records have come from beaches north of Perth (see WA report). In addition, single sightings have come from Nuytsland Nature Reserve in the Eucla Bioregion (e.g. Great Australian Bight) and from Hummock Island and southeast of Pelsart Island in the Abrolhos Islands (Abrolhos Bioregion).

In ***South Australia***, just over 200 sightings by beachcombers have been recorded to date, comprising a total of 830 seadragon specimens. 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 have been of *fresh* seadragons and 49 % refer to *old* specimens, 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 so far are of single specimens, although there are reports of pairs (11 % of beachwash records). One sighting of a live beached seadragon has been recorded (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 nine adult weedies and one adult leafy recorded at the Sellicks - Aldinga Beach area in 1992, over the month of January. Beachwashed seadragons have been recorded from more than 60 locations along the South Australian coast. These records are discussed in detail on a bioregional basis, in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

There are records of small groups of seadragons or single specimens being washed up on beaches, after high tides, storms and/or large swells. In SA, around 15 % of the 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 five 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 a stormy period that had lasted a few days,
- two fresh weedies washed up at Port Willunga Beach in July 1995 following stormy weather and two 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,
- eight adult weedies and one 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 three or four days before the sighting,
- a fresh juvenile leafy washed up on Somerton Beach in October 1998, after a storm and
- a fresh leafy washed up at Fishery Bay (Port Lincoln) in January 2003, after heavy weather.

There are beach records of 'masses' of dead seadragons, some coinciding with the first major recorded pilchard 'die - off' event in South Australia (in 1995 - 96), and many more coinciding with the second pilchard death event of late spring 1998 to late summer 1999, believed to be viral-related (Ward et al., 2001). Beachcombing records in the main SA 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 SA waters (1998 - 1999). Beachwash sightings, for which dead pilchards were also recorded with the seadragons, include those in **Table 14**, in reverse chronological order. In addition to those records detailed, there were several other records of seadragon deaths (including mass numbers) which occurred during the timing of the second major pilchard kill event (1998 - 99) recorded along the South Australian coastline, but these 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.

Table 14: Beachwash seadragon sightings and associated details recorded during 'pilchard die-off' events in South Australia

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 10 juveniles	"Found washed up with pilchards and the odd puffer fish after stormy conditions the day before"
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]
February 1999	South Brighton	1 adult leafy	"Found washed up in a pilchard die-off wash".
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"

Table 14: cont.

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)
November 1998	Head of Great Australian Bight	7 adult weedies	"Coincided with pilchard kill". "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".

Several other records which coincided with the mass pilchard die-off events in 1998 and 1999 in SA, included:

- around 250 weedies sighted on Mt Camel Beach in December 1999,
- six weedies recorded from Cape Kersaint (Kangaroo Island) in February 1999 and
- 20 leafies recorded at Mt Camel Beach (Anxious Bay) in December 1999.

It is noted that there are other records of mass numbers of seadragons in the beachwash, not coinciding with the pilchard die - offs, and such events may be related to oceanographic factors, perhaps unusually strong winds (which can also strand rafting seahorses in large numbers), or phytoplankton blooms.
Examples include:

- approximately 12 weedies and 12 leafies recorded from the Mt Camel Beach (Anxious Bay) in January 1993, and 6 leafies recorded on Mt Camel Beach in January 1990,
- eight weedies recorded from Vivonne Bay (Kangaroo Island) in December 2001 and
- 30 weedies recorded at Sensation Beach in the Coffin Bay National Park in March 2002.

In ***Victoria***: 26 sightings of beached seadragons have been recorded, comprising a total of 31 specimens. More than half of all sightings were recorded between late spring (November) and the end of summer (February). Thirteen of the 26 records refer to fresh seadragons, and two of those records also reported old specimens during the same sighting. To

date, 17 old beachwashed seadragons have been recorded, mostly as single specimens, although there is a record of three old seadragons recorded from a beach near Somers in November 1998. Only one live 'beached' seadragon has been recorded to date (from Merricks Beach in August 2002), with that being an adult weedy that appeared to have difficulty maintaining an upright position in shallow water, due to body damage. To date, no 'mass mortality' events have been recorded in the Victorian Dragon Search database. All but three of the beachwash records were of single specimens. Apart from the record of three seadragons on the beach at Somers, there were two records each specifying one fresh and one old seadragon, from Shoreham Foreshore Reserve in January 1999, and from Moggs Creek Beach (near Aireys Inlet) in December 1997. Beachwashed seadragons have been recorded from 15 locations around Victoria. The bioregional distribution of these records is discussed in the Victoria report (http://www.reefwatch.asn.au/PDF/DragonSearch_Vic_April2005.pdf)

In ***Tasmania***: 46 sightings of beached seadragons have been recorded to April 2005, comprising a total of 74 specimens. More than half of all sightings to date were recorded between late spring (November) and the end of summer (February). Sixteen of the 46 records refer to *fresh* seadragons (comprising 23 specimens, including 8 juvenile weedies recorded in September 2000 in Cameron's Inlet at Flinders Island). There are 26 records of *old* seadragons, comprising 50 specimens. More than half of these records were of single seadragons, a few were pairs or small groups (three to four). There was one record from Whitemark Beach, Flinders Island (February 1998) of 14 seadragons recorded in the beachwash, and four old specimens were also recorded at that location, in January 1997. Beachwashed seadragons have been recorded from about 30 locations around Tasmania, with 11 records from Flinders Island, eight from Low Head, three each from Tomahawk, Georgetown, Eddystone Point, St Helens and Bicheno in the north, and Fortescue Bay in the south. At Bell Bay Beach, near Georgetown in northern Tasmania, there were two records each of three old specimens, recorded in February and September 2000. Pairs of dead weedies have been recorded at Falmouth on the east coast (two fresh specimens, from August 2001); Bell Bay Beach near the mouth of the Tamar; Patriarch Inlet on Flinders Island (two old specimens of juveniles); City of Melbourne Bay at King Island; and Fortescue Bay on the Tasman Peninsula (1 fresh and 1 old weedy, recorded in March 1999). West coast (Franklin Bioregion) records include one each from Marrawah and Point Hibbs (the latter comprising three old beachwash specimens, December 1997). There was one record from King Island, in the Otway bioregion.

In ***New South Wales***: 20 % (130) of the 629 records from New South Wales to June 2005 were beachwash reports. Forty one percent of all sightings occurred during the summer months, 32 % during autumn, 9 % during winter, and 19% during the spring months. Approximately 81 % of beachwash sightings have been of 'freshly dead' seadragons. Beachwashed weedies have been recorded from 55 locations along the New South Wales coast. The greatest number of dead weedy seadragon sightings from single localities have been from the Mona Vale area (total of 21 weedies); the Narrabeen area, including Collaroy Beach, Dee Why Beach and Narrabeen Headland (18 weedies); Newport (nine weedies); Austinmer and Thirroul Beach (11 weedies), and sites near Moruya and Wamberal (seven weedies). Largest numbers of weedies recorded in single sightings came from the Dee Why area (more than five weedies washed up in March 2002), and Bungan beach near Mona Vale (four weedies washed up in April 1998).

12. Other Data (depth; water temperature)

Table 15 summarises the depth range of seadragon sightings in the Dragon Search Program. Various locations from which deep and shallow records came are discussed in the reports for WA (Baker, 2002c), South Australia (Baker, 2005b) and Victoria (Baker, 2005c).

The data available 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), which also influences any summary of depth recordings.

Similarly, little can be inferred about seasonal depth variations in seadragon distribution from available data as:

- the number of sightings recorded per month is opportunistic, according to diver preferences,
- the survey was not standardised - i.e. seadragons were not searched for, at specific depths, in every month and
- the uneven numbers of records between months influences the range of the depth 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).

There could be other factors such as, 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. 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.

The published maximum depth for both species on the southern Australian coast is about 50m (Kuiter, 2000, 2003; Edgar, 2000; Australian Museum, 2004b). With consideration of the caveats listed above, the deepest depth records reported to Dragon Search have been:

- a record in the SA historical database of a leafy observed on the reef at 40 m sighted during a dive in the late 1960s, off Cape Cassini (Kangaroo Island) (see ***PART 2: Historical Data*** in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf),
- 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,
- a sighting of a weedy at the *Nord* wreck in the Port Arthur area of southern Tasmania, at 37m deep and
- a sighting from a reef in the Esperance area in WA (December, 1999).

Table 15: Depth range of Dragon Search sightings of seadragons in each State, W = weedies, L = leafies

State	No. of sightings for which depth was recorded	Depth (m) range for all sightings (1990 – 2005)	Depth (m) range for majority of sightings
NSW	W: 489	W: 2 - 32	95 % of W: 5 - 26
VIC	W: 100 L: 18	W: 1 - 14 L: 2 - 14	92 % of W: 1 - 6
SA	W: 202 L: 362	W: 1 - 22 L: 1 - 20	75 % of W: 3 - 12
TAS	W: 160	W: 1 - 37	66 % of W: 3 - 15
WA	W: 262 L: 126	W: 1 - 19 L: 2 - 36	90 % of W: 2 - 12 87 % of L: 2 - 14

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. **Table 4** in Section 5 summarises sightings in each State according to season. Reports for WA (Baker, 2002c), South Australia (Baker, 2005b) and Victoria (Baker, 2005c) provide examples of locations and dates for the records during which the maximum and minimum temperatures were recorded.

Table 16: Temperature range of Dragon Search sightings of seadragons in each State, W = weedies, L = leafies

State	No. of sightings for which temperature was recorded	Temperature (^{o}C) range for all sightings (1990 – 2005)	Temperature (^{o}C) range for majority of sightings
NSW	W: 472	W: 12 - 24	99 % of W: 14 - 23
VIC	W: 79 L: 13	W: 8 - 21 L: 8 - 21	94 % of W: 12 - 21 93 % of L: 15 - 21
SA	W: 117 L: 215	W: 11 - 24 L: 12 - 24	73 % of W: 16 - 22 66 % of L: 16 - 22
TAS	W: 131	W: 8 - 20	89 % of W: 11 - 17
WA	W: 193 L: 91	W: 14 - 28 L: 16 - 25	93 % of W: 17 - 23 93 % of L: 18 - 23

13. 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 significance include the following:

Jetties / Piers: In **South Australia** and **Victoria**, there are a disproportionately high number of reports from diving at jetties, due to repeat sightings at popular dive spots where seadragons are known to occur. A smaller number (17) of jetty reports came from WA, three records from New South Wales, and one from Tasmania. In SA there have been 278 jetty records to date (collectively from 18 jetties), and in Victoria, 71 jetty records (from five jetties). Generally in SA most jetties along the lower Fleurieu and lower Yorke Peninsula (GSV side) are important habitat for seadragons. Specific examples in SA include Rapid Bay Jetty (from which 60 % of all SA jetty reports have come – see section below on **Rapid Bay**, for more information); a jetty on north-eastern Kangaroo Island (12 % of SA jetty reports), and two jetties in south-eastern GSV (6 % of records each). A number of seadragons and seadragon groups are known to be 'site-associated' with such jetties and are therefore recorded repeatedly by divers. Despite this bias, it is clear that jetty structures in each State, particularly in SA Victoria and WA, provide important additional 3 - dimensional habitat for seadragons of both species. There have been a number of sightings from 12 other jetties in South Australia, and these are discussed in the internal report on South Australian Dragon Search data (Baker, 2005a).

In **Victoria**, about 47 % of the records come from jetties (called 'piers' in Victoria). Popular jetties for viewing seadragons in Victoria include Portsea Pier (43 records) and *Flinders Pier* (19 records). There are also sightings from three other piers in Port Phillip Bay. Portsea Pier is widely promoted in dive tourism materials as a site where resident weedy seadragons can be viewed, and is popular with local, interstate and international divers. At Flinders Pier, one diver has regularly recorded seadragons near the pylons, and also just above plant cover, close to the sandy bottom.

In **Western Australia**, six of the 17 jetty records (to April 2005) came from a jetty in the Esperance area, and five from Busselton Jetty, a popular and widely promoted dive spot, where there is now an observatory and interpretative centre at the end of the jetty. Other jetty records included those at Woodman Point, Fremantle and Rottnest Island.

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 SA and on a wreck near Port Arthur in Tasmania. In SA, a total of 35 records (31 of which refer to weedies) have been reported, from artificial reefs in southern metropolitan GSV (11 records), central metropolitan GSV (10 records), northern metropolitan GSV (nine records), wrecks off the Glenelg area (two records and one record respectively) and a wreck in the southern metro beaches area (one record). Those structures remaining in the northern metro area may be particularly important as additional seadragon habitat, given both the pollution-induced decline in seagrass beds and the cover of macroalgae on patch reefs and has occurred in the area during the past few decades (see Baker, 2005b).

WA - Bremer Bay: Bremer Bay is a popular site for photographing seadragons and is a site promoted in dive magazines as one in which resident seadragons can be seen regularly by divers and tourists. A dive shop operator in the area has counted seadragons seen on dives during the past decade, and recorded behaviour (cited in Morrison, 2005). A number of television channel crews, journalists for magazines and newspapers, and photographers have visited the area during the past seven years. Beros (2000) as well as the diving magazines such as SCUBA Australia (2002) reported the

disappearance of seadragons in the area (possibly due to poaching), following media exposure in the early 2000s of the site-associated seadragons in Bremer Bay. In May 2002, a Dragon Search reporter stated that the recording of leafies at the said reef in Bremer Bay around that time was the first sighting in the area for 12 – 18 months.

WA - Cottesloe Reef and Surrounds: To April 2005, there have been 20 records of weedy seadragons sighted at Cottesloe and six records of leafies. The seadragons at Cottesloe Reef have social importance, and a local environment group (the Cottesloe Marine Protection Group) has been working since 1998 to: protect the biodiversity of the reef system at Cottesloe; increase scientific research into human impacts in the area; increase public recognition of the significance of Cottesloe's seagrass beds and limestone reef system for seadragons (including its role as a breeding area for weedy seadragons and nursery area for Port Jackson sharks), and campaign for the weedy seadragon to be protected under WA legislation (Beros, 2000; McCauley and Macintyre, 2002). The Cottesloe Marine Protection Group has adopted the weedy seadragon as its logo (D. Beros, AMCS – WA, pers. comm., 2003). According to McCauley and Macintyre (2002), the Cottesloe reef system is one of only two reef systems existing along Perth's metropolitan coastline, and stretches intermittently for approximately 4.4 kilometres from Cable Beach to North Street, Cottesloe. It is located on a 1.5 kilometre wide limestone shelf, which is locally known as the Cottesloe Fringing Bank.

The Cottesloe Marine Protection Group, formed by a group of local snorkellers, has been concerned about human impacts such as recreational spearfishing, damage from boat anchors, collecting of marine biota and rocks, and discharge of nutrient-enriched stormwater and groundwater in the area. The coastal discharges have promoted the excessive growth of nuisance green algae, which was smothering seagrasses and reefs in the area, particularly during the late 1990s. The group has been working with the WA government to generate awareness of the problems, and to improve management of the impacts. McCauley and Macintyre (2002) reported that following several years of successful campaigning, public and school education programs, media promotion, and preparation of a detailed management plan, there is now a great sense of community custodianship, and a strong public interest in helping to preserve the area for the long term. The Cottesloe Reef area was declared a Fish Habitat Protection Area in 2001, under WA Fisheries legislation, and is managed by the local community. There is an annual community event (Cottesloe Seadragon Festival) to highlight the significance of the area as seadragon habitat, and to promote the need to protect the local marine environment from impacts.

***SA - 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 recorded there regularly. 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 approximately 21 % of all sightings in the database (including some 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 seen regularly require boat access, but Rapid Bay can be reached from the shore, which adds to its popularity. During the late 1990s and early 2000s, the South Australian government tourism agency promoted the legislatively-protected leafy seadragon in its international literature, as a focus for marine tourism, and

Rapid Bay was promoted as one of the easily accessible locations where tourists who visit SA 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. During the early 2000s, a *Code of Conduct* (Reef Watch 2002) for diving near seadragons was developed by Dragon Search (SA) and its partner organisations, in conjunction with the SA Department for Environment and Heritage (Coast and Marine Branch) and Primary Industries & Resources SA (Marine Habitat Program). The development of this Code was prompted by the frequent diving at some sites where seadragons are resident, particularly Rapid Bay, and the potential for disturbance of seadragons by over-enthusiastic divers. There is a biennial Leafy Seadragon Festival at Yankalilla (north of Rapid Bay), to raise awareness of the leafy seadragon as the State fish emblem of South Australia, and also serves to promotes the environment, arts and culture of the southern Fleurieu region, which is a significant habitat for seadragons.

SA - 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 SA Dragon Search database (i.e. not including 'historic' records). Thirteen of these records were repeat dives at a site where one Dragon Search recorder monitored a group of leafy seadragons during 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 5 m and 8 m depth, at the junction of rocky reef (e.g. with *Cystophora* species and *Seirococcus*) and seagrass (*Amphibolis*) (SA Shepherd, pers. comm. to Dragon Search, 2002). At the site where leafies were recorded in 2001, juveniles were recorded in recesses / crevices in the reef, or near boulders, near thick cover of *Ecklonia*, or near the vertical face of the reef, all of which offer protection from currents. Adults were mostly observed near *Ecklonia* kelp. There is also an unusual record of approximately 100 leafies that were observed in a 'mass aggregation', during a night dive in June 1994 in a mixed habitat (mainly seagrass, but near some *Ecklonia* and other brown macroalgae cover). Many of the sightings of weedies in the Encounter Bay region come from seaweed-covered reef near sand, or from mixed seagrass / sand and seaweed / reef habitat. Weedies have occasionally been observed in shallow rock pools around islands in the bay. Between 1991 and 2005, there were 43 beachcombing sightings from the Encounter Bay region including sightings of 'mass numbers' at The Groynes / Hindmarsh River estuary area (15 weedies recorded in seagrass at the high tide mark in February 1997), Kent Reserve (40 dead weedies reported in November 1998 which coincided with the timing of the second major pilchard kill event in South Australia), Chiton Rocks area, and between Hindmarsh River and Chiton Rocks: seven records between 1995 and 2002, including notable sightings in March 1997 of six weedy specimens (a mix of fresh and old specimens).

SA - Northern and North-Eastern Kangaroo Island: Some of the reefs around northern and north-eastern Kangaroo Island (KI) are known locally, nationally and internationally as tourist destinations for diving with seadragons, and regular dive trips to these locations have occurred during the 1990s and early 2000s, for seadragon viewing. There are many sightings of leafies (94 records, between 1992 and 2002) from the Dudley Peninsula area and several sightings from other parts of north-east KI. The north-eastern KI records, including repeat KI Island were provided by a KI diver, who regularly records seadragons, and their characteristics (e.g. size). The seadragon records provided to Dragon Search are one example of the regularity of sightings in the area. Seadragons are almost always seen during dive charter tours in the northern KI area. The regularity with which seadragons have been observed at

specific locations around northern and north-eastern KI, over the period of a decade, indicates a strong degree of site association of the leafy seadragons in that area. The north-eastern KI reefs are situated in an area of steep depth gradients and high current flow, and the area is unique within the GSV Bioregion in terms of both 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 seadragons in areas of dense human population and / or modified habitats that have been subject to high levels of human-induced impacts during the last century. These include nutrient-induced seagrass loss and nearshore reef damage due to declining water quality, including siltation of reef surfaces (e.g. due to coastal developments and associated discharges). **Table 17** summarises the Dragon Search records (1990 - 2005) from the metropolitan area in each State.

Table 17: Summary of Dragon Search records (1990 - 2005) that have come from the metropolitan area in each State

State	No. of records (to 2005)	Examples of metropolitan locations in which seadragons were recorded during Dragon Search (alphabetical order)
NSW (Sydney area only; excluding Wollongong & other NSW cities)	~approximately 340	• Bondi, Clovelly, Collaroy, Coogee, Cronulla, Kurnell, La Perouse, Manly, Maroubra, Mona Vale, North Head, Palm Beach, Port Hacking, South Head, Sydney
SA	118	• Brighton / South Brighton, Glenelg area, Grange Tyre Reef, Henley Beach, Kingston Park Marino / Marino Rocks, Seacliff area, Semaphore / Semaphore Park Somerton area, Tennyson, West Beach, West Lakes shore
TAS	46	• Blackman's Bay, Dodges Ferry, Dunalley, Hobart, Kingston Beach, Snug, South Arm, Taroona
WA	64	• Cottesloe, Hillary's Boat Harbour, Marmion, Scarborough, Sorrento, Trigg

The metropolitan area sightings detailed above include those from waters close to the beach areas of high human usage, and numerous pollution sources. In South Australia, the significance of records from the Glenelg area (which has been subject to sewage pollution and sedimentation over a number of decades) is discussed in the State report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

In ***Western Australia***, apart from the Cottesloe sightings mentioned above, there have been approximately 12 sightings from the local metropolitan area near Perth (LNE Bioregion), including areas such as City Beach, Floreat, Swanbourne, Mosman Park, and Hale Road. Sites further north of Perth, in the CWC Bioregion, such as Trigg Beach and Scarborough (10 records collectively), Marmion (13 records) and Hillary's Boat Harbor (14 records), are also important sighting locations and around two - thirds the reports from these areas have recorded weedy seadragons. Surprisingly, there have been three records from the Swan River, one referring to a live weedy adult observed during a dive at 12 m in the Swan River at Mosman Park, which is more than 6 km from the sea, and one record of two leafies observed closer to the mouth of the Swan River, near Fremantle. If verifiable, the record from Mosman Park during the Dragon Search program in any State represents the only true river sighting of a live seadragon. There are 35 records in the WA database from Fremantle, including two popular metropolitan diving sites where the Swan River meets the Indian

Ocean. Such metropolitan sightings are significant, because there are few areas in southern Australia where seadragons are commonly observed in the metropolitan waters, close to the city, beaches and ports of high human usage, and numerous pollution sources.

In all southern States, the importance of developed, metropolitan areas for seadragon populations should be considered in the management and mitigation of urban pollution sources, and in local coastal marine development plans.

Victoria – Queenscliff: About 25 % of the Victorian Dragon Search records have come from the Queenscliff area, principally a popular dive spot known as Cottage by the Sea, which is promoted by dive groups as a location where seadragons and various reef fish can be observed.

NSW - Kurnell: To June 2005, 18 % of the NSW Dragon Search records have come from locations around Kurnell, near the southern entrance to Botany Bay. Various dive sites in the Kurnell area are popular for viewing weedy seadragons, and some dive clubs run regular trips to the area. Kurnell is one of the locations visited by dive tourists who wish to view and photograph seadragons. Records from the Kurnell area range from 1993 to 2003, with half of those being recorded between 1999 and 2002. On Ocean Care Day in December 2000, dive clubs in NSW counted seadragons at Kurnell, in association with the Dragon Search program in NSW A student from the University of Barcelona tagged and studied seadragons during the early and mid 2000s at some sites in the Kurnell area (e.g. Sanchez-Camara and Booth, 2004; Sanchez-Camara et al., 2005).

NSW - Bare Island, La Perouse: Like Kurnell, Bare Island near La Perouse is widely known amongst the diving community as a site at which seadragons can be seen, and this feature of Bare Island is also promoted on national diving web sites as well as web pages of dive clubs and individual divers. To June 2005, 12 % of NSW Dragon Search records have come from the La Perouse area.

NSW – Jervis Bay: About 10 % of NSW Dragon Search records have come from locations in Jervis Bay, such as Bowen Island and The Docks. Diving with seadragons in Jervis Bay is promoted by a number of dive tourism operators and web sites.

NSW – Shellharbour: About 4 % of NSW Dragon Search records have come from the Shellharbour area, such as Bass Point. Like Jervis Bay, diving with seadragons in the Shellharbour area is promoted by a number of dive tourism operators and web sites.

NSW - Maroubra: About 3 % of NSW Dragon Search reports have come from Magic Point at Maroubra, a popular dive site for viewing Grey Nurse Sharks and seadragons.

NSW – other sites: Examples of other sites where seadragons are commonly sighted include Cronulla (4 % of records to mid 2005), North Head and South Head (nearly 5 % of records collectively) and Manly (3 % of records).

TAS - Waterfall Bay and Deep Glen Bay: 18 % of the Tasmania Dragon search sightings (including repeat sightings on single occasions) have come from dives at Waterfall Bay (11 %) and Deep Glen Bay (7 %) in the Eaglehawk Neck area. Locations in the Eaglehawk Neck area are some of the most widely promoted for SCUBA diving in Tasmania.

TAS – Blackman's Bay: About 8 % of the Tasmanian records have come from Blackmans Bay sites, such as Mirramar Park. Some of these records were repeat sightings on the same days, which inflate the significance of the locations in the reporting, as is the case for the Eaglehawk Neck area. Blackman's Bay is promoted by SCUBA diving web sites as a location where seadragons can reliably be seen.

TAS – Port Arthur area: About 8 % of the Tasmanian records to June 2005 came from the Port Arthur area on the Tasman Peninsula.

14. Seahorse and Pipefish Sightings

Table 18 summarises the sightings of seahorses recorded incidentally in each State during the Dragon Search program. In **South Australia**, the main two species that occur are the Short-headed (also know as Short-snouted) Seahorse *Hippocampus breviceps* and Southern Pot-bellied Seahorse *H.* cf. *bleekeri* (a southern form related to *H. abdominalis* and *H. bleekeri*), and both were sighted during the Dragon Search Program. There are several seahorse species in **Western Australia**, however the most commonly sighted in the south-western area (from which the majority of Dragon Search records came) is *Hippocampus subelongatus* (also known as *H. elongatus*), the Western Australian Seahorse. In **New South Wales**, White's Seahorse (*H. whitei*) and the Pot-bellied Seahorse *H. abdominalis* are two of the commonly observed species. In **Tasmania**, there were also two reports of pipehorses (*Solegnathus* species) from Bruny Island and Flinders Island.

Table 18: Summary of seahorse sightings recorded incidentally during the Dragon Search Program in each State.

State	Total no. of seahorse sightings (to 2005)	Example locations
NSW	**21**	• Manly, North Head & South Head, La Perouse, Kurnell, Botany Bay, Cronulla, Tathra & Eden
VIC	**15**	• Piers at Rye, Flinders, St Leonards, Portsea, Portsea Reef, Portland Breakwater, Curdies River (beachwash record, in 'historical' database)
SA	**31**	• Edithburgh jetty, Jetties at Port Giles, Wool Bay and Kleins Point, Venus Bay, Corvisart Bay (Back Beach) in the eastern Great Australian Bight, Tumby Bay jetty, Spencer Gulf, Sellick's Beach, Carrickalinga Beach, Encounter Bay
TAS	**17**	• Port Arthur, Blackman's Bay, Kingston, Hobart, Tinderbox, Dodges Ferry, Snug, Bicheno
WA	**8**	• Bremer Bay, Albany area (including a sighting of 36 individuals), Rockingham area (e.g. Warnbro and Palm Beach), Busselton, Fremantle

Pipefish: Pipefish sightings are summarised in **Table 19**. The Dragon Search database reports for Western Australia (Baker, 2002c), South Australia (Baker, 2005b), Victoria (Baker, 2005c) and Tasmania (Baker, 2002e; Woodfield, 2003) discuss in more detail the pipefish sightings in those States.

Table 19: Summary of pipefish sightings recorded incidentally during the Dragon Search program in each State.

State	Total no. of pipefish sightings (to 2005)	Example Locations
NSW	15	• South West Rocks, Swansea, Catherine Hill Bay, Palm Beach, Mona Vale, Manly, South Head, Chowder Bay (Clifton Gardens), Bondi, Maroubra, La Perouse, Kurnell, Shellharbour, Bawley Point, Eden
VIC	5	• Portsea (pier and reef), Flinders Pier, Queenscliff
SA	43	• Rapid Bay Jetty (29 sightings, including several sightings of large numbers of pipefish; more than one species recorded), Second Valley, Sellicks, Aldinga, Port Noarlunga, Jetties in Encounter Bay and Fishery Bay, Jetties at Edithburgh, Port Giles, Wool Bay and Klein's Point
TAS	2	• Kingston Beach, Fortescue Bay
WA	17	• Bremer Bay, Albany, Busselton, Fremantle, Geraldton

Ghostpipefish: In New South Wales, two sightings of the widespread tropical Indo - Pacific species Ornate Ghostpipefish *Solenostomus paradoxus* have been reported to Dragon Search. Ghostpipefish, in the family Solenostomidae, differ in several ways from fish in the Syngnathidae (seahorses, pipefish, seadragons, etc), including the presence of two dorsal fins, and the fact that the female ghostpipefish looks after the eggs in a pouch formed by her enlarged pelvic fins (Australian Museum, 2004c).

15. Other Notable Species

Some of the other fish species observed and recorded during Dragon Search include those in the **Table 20**. Site-specific details are available in the State reports (e.g. Baker, 2002c, 2002e, 2005b, 2005c).

Table 20: Summary of other notable species recorded incidentally during the Dragon Search Program in each State.

Species / species group (alphabetical order)	No. of records (to May 2005)	Sighting details
Anglerfish (Antennariidae)	**SA:** 3	• **SA**: Rapid Bay, Edithburgh Jetty, Wool Bay
Banded morwong (*Cheilodactylus spectabilis*)	**TAS:** 11	• **TAS**: 4 from the Tasman Peninsula, 3 from Bruny Island, 1 from Blackman's Bay and 3 from northeastern and eastern Tasmania – St Helens and Coles Bay)
Cowfish = Ornate cowfish (A*racana ornate*) and / or Shaw's Cowfish (*A. aurita*)	**SA:** 27 **VIC:** 5 **TAS:** 17 **WA:** 2	• **SA**: Rapid Bay, Point Turton, jetties in W & SW GSV, reefs in the Glenelg area: Henley Beach (beachwash), metro tyre reefs • **VIC**: Portsea Pier, Flinders Pier, Portland • **TAS**: mostly from Tasman Peninsula (e.g. Pirate's Bay & Waterfall Bay near Eaglehawk Neck) & sites south of Hobart such as Kingston, South Arm, Blackman's Bay and Bruny Island • **WA**: Busselton, Dunsborough
Dusky morwong (*Dactylophora nigricans*)	**SA:** 19 **WA:** 2	• **SA**: Rapid Bay, Second Valley, Seaford, Seacliff, reefs off Glenelg, metro tyre reefs, jetties in W and SW GSV, Gerloffs Bay (south-eastern SA) • **WA**: Fremantle, Burns Rocks
Eagle ray (*Myliobatis australis*)	**SA:** 3	• **SA**: Searcy Bay, Stokes Bay (KI), Flinders Island 'Hotspot' (eastern Great Australian Bight)
Handfish (Brachionichthyidae)	**TAS:** 1	• **TAS**: Fortescue Bay on the Tasman Peninsula
Seamoth (*Pegasus lancifer*)	**SA:** 1	• **SA**: 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)
Southern blue devil / Western blue devil (*Paraplesiops meleagris*)	**SA:** 22	• **SA**: Second Valley, Seacliff Reef, Seaford Reef,; reefs off Glenelg, a site east-north-east of Penneshaw (KI), 'The Gap' at Innes National Park
Stingarees (e.g. Crossback stingaree *Urolophus cruciatus*)	**TAS:** 5	• **TAS**: Tasman Peninsula, Blackman's Bay area and Coles Bay (east coast)

Table 20: cont.

Various wrasse species, such as: • Blue-throated wrasse (*Notolabrus tetricus*) • Black-spotted wrasse (*Austrolabrus maculates*) • Brown-spotted wrasse (*Notolabrus parilus*) • Senator wrasse (*Pictilabrus laticlavius*) • Western foxfish (*Bodianus frenchii*) and other wrasse species	**SA:** 30 **VIC:** 12 **TAS:** 27 **WA:** 7	• **SA**: Gerloff's Bay in the lower South-East, a site southwest of Blackfellow's Caves (South-East of SA), Second Valley, Rapid Bay Jetty, Seacliff, Seaford, Glenelg, Western River Cove (northern KI), Stokes Bay (northern KI), east north-east of Penneshaw (KI), Edithburgh Jetty (Yorke Peninsula), between Hopkins and Thistle Island (lower Spencer Gulf), and Frenchman's Bluff (Coffin Bay) • **VIC**: Portsea Pier, Flinders Pier, Point Lonsdale • **TAS**: Woolnorth Point, Rocky Cape, St Helens, Bicheno, Coles Bay, Bruny Island, South Arm, Tinderbox, Blackman's Bay, Fortescue Bay, Eaglehawk Neck, Port Arthur. • WA: Hopetoun, Esperance, Sorrento
Western blue groper (*Achoerodus gouldii*)	**SA:** 9 **WA:** 1	• **SA**: Rapid Head, Rapid Bay, Second Valley, Stokes Bay (KI), Wedge Island, Hopkins and Thistle Islands area, Flinders Island 'Hotspot' and Wedge Island • **WA**: Esperance

Other notable records of bony and cartilaginous species observed during the Dragon Search Program are discussed in the reports for Western Australia (Baker, 2002c), Tasmania (Baker, 2002e; Woodfield, 2003), South Australia (Baker, 2005b) and Victoria (Baker, 2005c). It is noted that a whale was sighted during one of the Dragon Search recordings in Tasmania (Adventure Bay, Bruny Island, November 1997).

16. Perceived Threats to Seadragon Populations

To date, in the Dragon Search databases, there has been little specific and usable information about other activities and threats in the areas where seadragons have been sighted.

In the ***South Australian*** Dragon Search database 42 % of the records (mainly from diving) specified other activities occurring in the area in which seadragons were sighted. Around 78 % of these records reported fishing and/or boating in the vicinity of 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 the 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, such as rubbish, siltation, sewage run - off or fishing debris. More details are available in the South Australian report (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

Although not obvious from the Dragon Search reports of threatening processes, perhaps one of the biggest concerns for seadragons in South Australia is a 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). In general, 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, 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 (e.g. from sand dredging, sewage and stormwater run – off, land reclamation and coastal erosion). Declines in seagrass and reef macroalgae cover may have a negative impact upon populations of seadragons by reducing available habitat in which life processes can be carried out. Examples of key locations where such impacts have occurred are provided in the State reports, particularly South Australia (http://www.reefwatch.asn.au/PDF/DragonSearch_SA_May2005.pdf).

During the past decade, a number of programs in southern States have highlighted the importance of reducing coastal river and estuary pollution, reducing runoff from coastal areas, and maintaining the health of catchments with regard to seadragon habitat in nearshore coastal waters. Examples include the Bungala River project in South Australia and the Leafy Seadragon Clean Drains Program in WA - the latter an education program that aimed to reduce the amount of industrial and domestic pollutants entering the ocean (via stormwater) from Margaret River, West Bay Creek, Cowaramup Brook, Boodjidup Brook and Blackwood River.

Fishing Impacts: As shown in the section on **Summary of Sighting Modes**, few seadragons caught as bycatch of fishing activity have been reported to Dragon Search. These reports may represent only a portion of those seadragons captured in prawn trawls and other types of fishing net, but the total number of seadragons caught annually as bycatch by these fishing methods in various regions is not known. In **South Australia** there is a noteworthy report (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 one or two, but sometimes up to 15 animals) were observed in the trawl bycatch, from waters deeper than 30 m, approximately 10 miles offshore from Cowell, in a habitat of reef ledges, with various sponges and seagrass in the vicinity. More recently, during a survey of bycatch in the Spencer Gulf Prawn Trawl fishery (Currie et al., 2009), 120 samples were taken between Point Lowly in the north, and Thistle Island in the south, and of the 7 species of syngnathids recorded, Weedy Seadragons comprised the largest catch (41 specimens from 10 trawls) followed by Leafy Seadragons and Big-belly Seahorses (21 specimens each). Most of those specimens captured were taken from areas of low trawl intensity, or from sites closed to trawling (Currie et al., 2009). In ***Western Australia*** seadragons have occasionally been caught in lobster pots, fishing gear (e.g. Fremantle) and commercial purse seine nets (e.g. Albany area, two records). In ***Victoria*** there was one record from a fish trap (Queenscliff area). Netting (including graball nets) and cray pots were also listed as threats to seadragons in a number of the records in the Tasmanian database.

Aquarium Trade: In each State, the take of seadragons for the aquarium trade is regulated by government authorities at both State (e.g. Department of Fisheries in Western Australia, PIRSA in South Australia, DPI in Victoria: Commercial Fishery General permit and Protected Aquatic Biota Permit) and Commonwealth levels (e.g. Authority to Export exemption permit under CITES section 59 and Declaration of an Approved Wildlife Trade Operation under the EPBC Act 1999). A number of permits have been issued during the past decade. Under these permits, a specified number of

male seadragons with eggs are taken from the wild for aquarium hatching and sale of young. The extent of the illegal trade in seadragons in southern Australian States is not known, but it is noted that exports of syngnathids are strictly regulated by the Commonwealth and States. To date, only one record in the Dragon Search database has provided details of likely poaching activity, this being from southern Yorke Peninsula in South Australia (1995). Possible poaching from northern Kangaroo Island in South Australia was also reported to government in 1997.

17. 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 continued to submit their records. The Dragon Search Program also thanks the various organisations, government programs and companies listed on page 1 that have supported and/or promoted Dragon Search throughout southern Australia.

South Australia: thanks go to Tony Flaherty (Marine and Coastal Community Network), Jeremy Gramp (Dragon Search Project Officer) and Vicki-Jo Russell (Threatened Species Network), who 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.

Victoria: in addition to all of those organisations listed on page 1 of this report, particular thanks go to staff and volunteers from the Marine Discovery Centre at Queenscliff, who have managed the Dragon Search Program in that State.

Tasmania: the Dragon Search Program has been run by the Tasmanian Marine Naturalists Association (TMNA) since August 1997. Funding for Dragon Search in Tasmania was provided by Natural Heritage Trust grants through the Fishcare, Coastcare, Coast and Clean Seas and the Fisheries Action Plan programs. In Tasmania, recreational divers, dive clubs and dive shops around the state were involved with the program. Craig Woodfield produced a database report for the TMNA in 2003 that included much of the reported work on the Tasmanian database by J. Baker (Baker, 2002a).

New South Wales: Dragon Search Project Officers have included Rebecca Raap, Craig Woodfield, David Bell and Effie Howe, who all collated data during various parts of the program. In 2002, Effie Howe also updated an earlier report by J. Baker (2000a) on the NSW Dragon Search data. Craig Bohm was NSW Coordinator with the Marine and Coastal Community Network and ran the project in that Sate.

Western Australia: Dragon Search thanks Dennis Beros, from Australian Marine Conservation Society WA, who collated the records, maintained the database, provided many of the geographical coordinates, and promoted Dragon Search in WA The Dragon Search program also thanks the WA Museum and the various organisations, government programs and companies listed on page 1, which have supported and / or promoted the Dragon Search Program in WA

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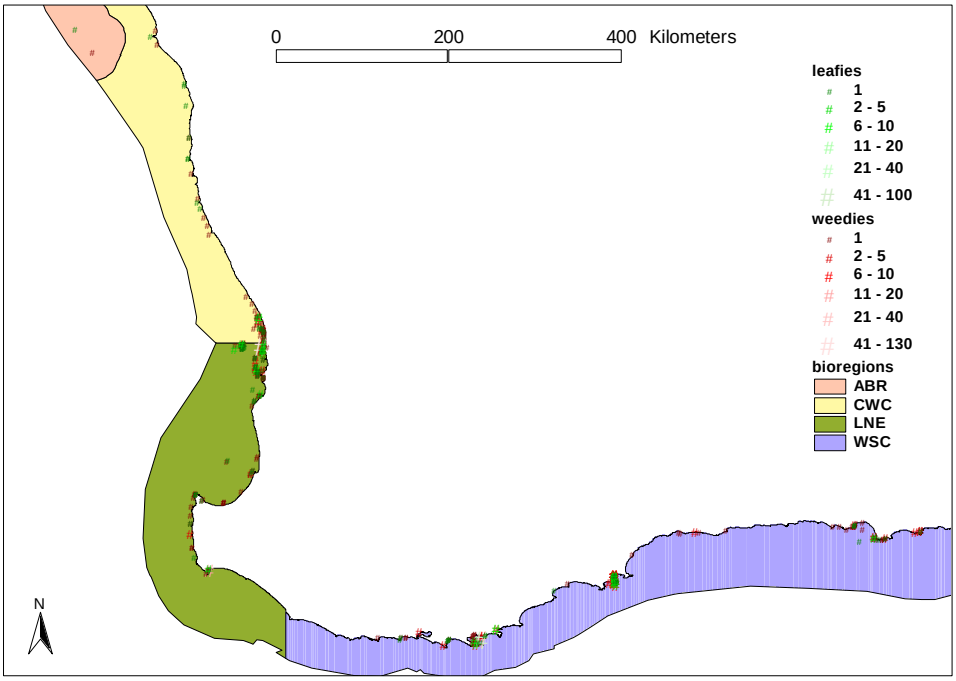
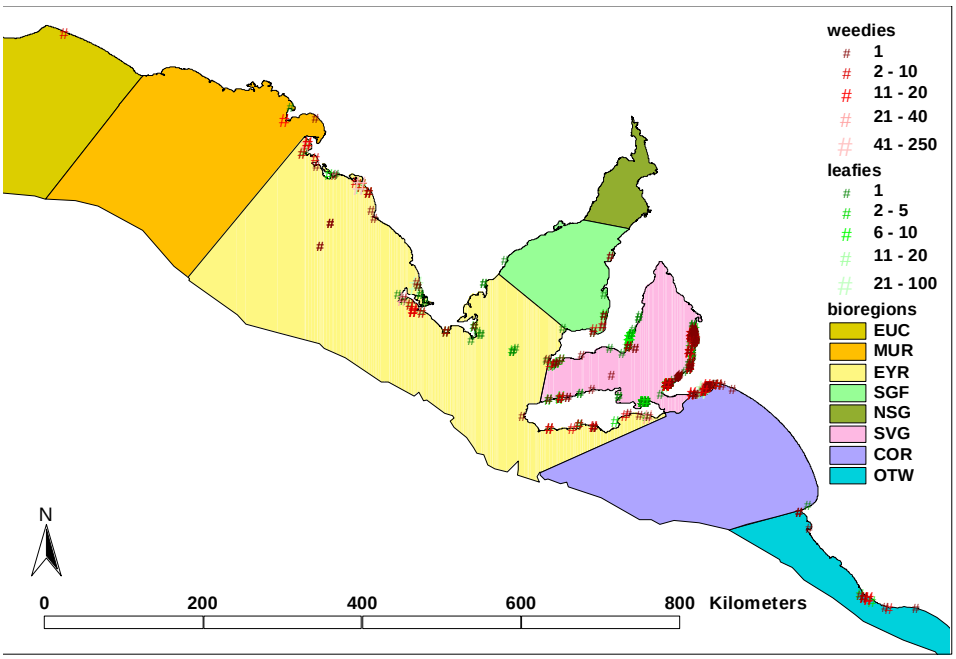
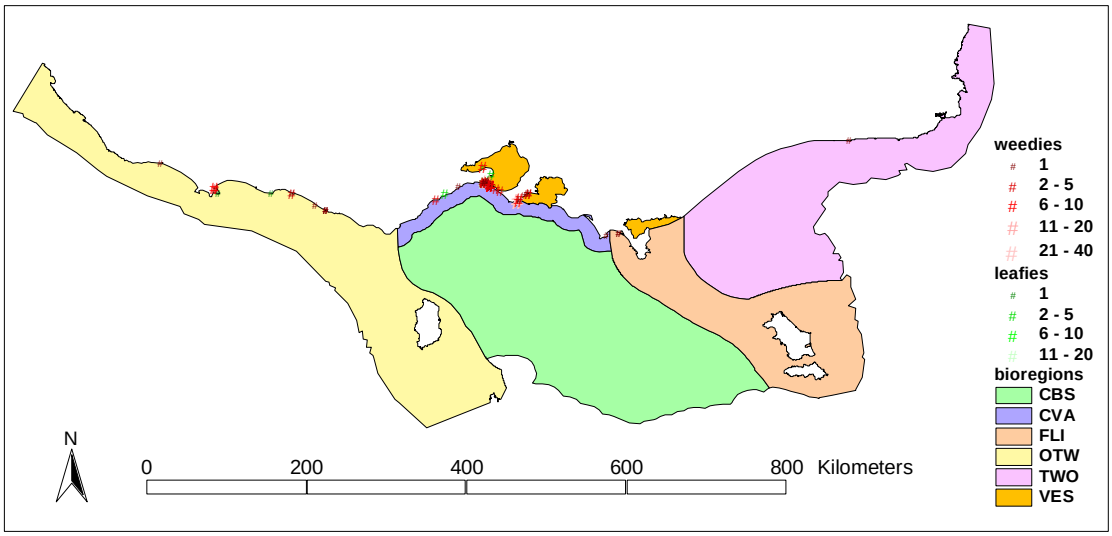
Appendix 1: Maps



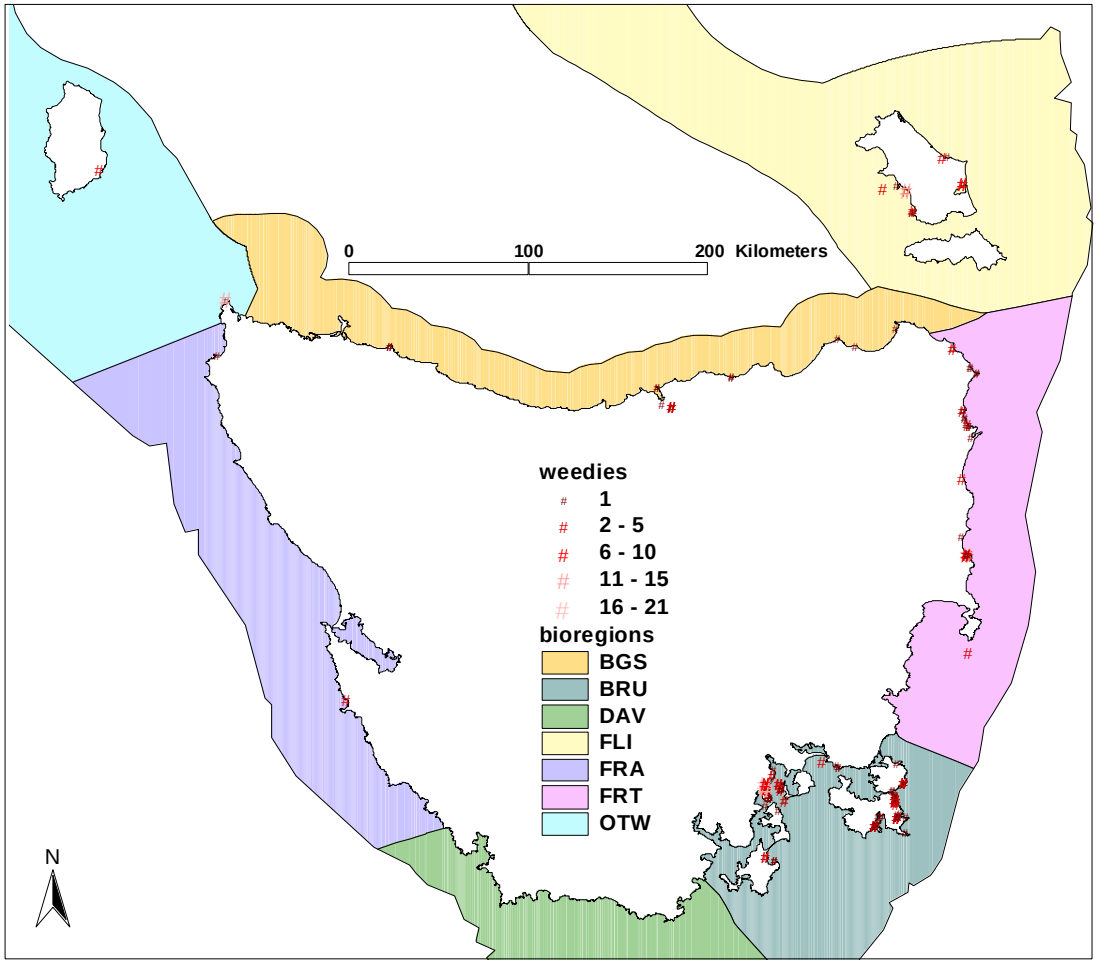
Map 2a: Seadragon sightings in Western Australian bioregions, July 1990 to April 2005.



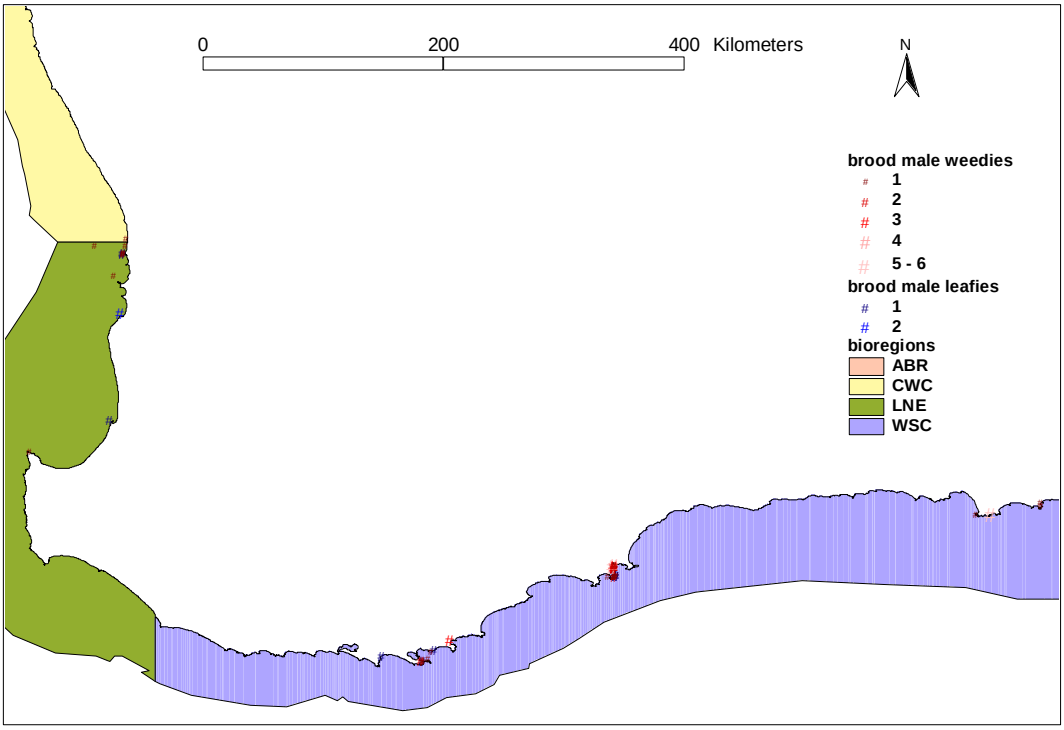
Map 2b: Seadragon sightings in South Australian bioregions, January 1990 to May 2005.



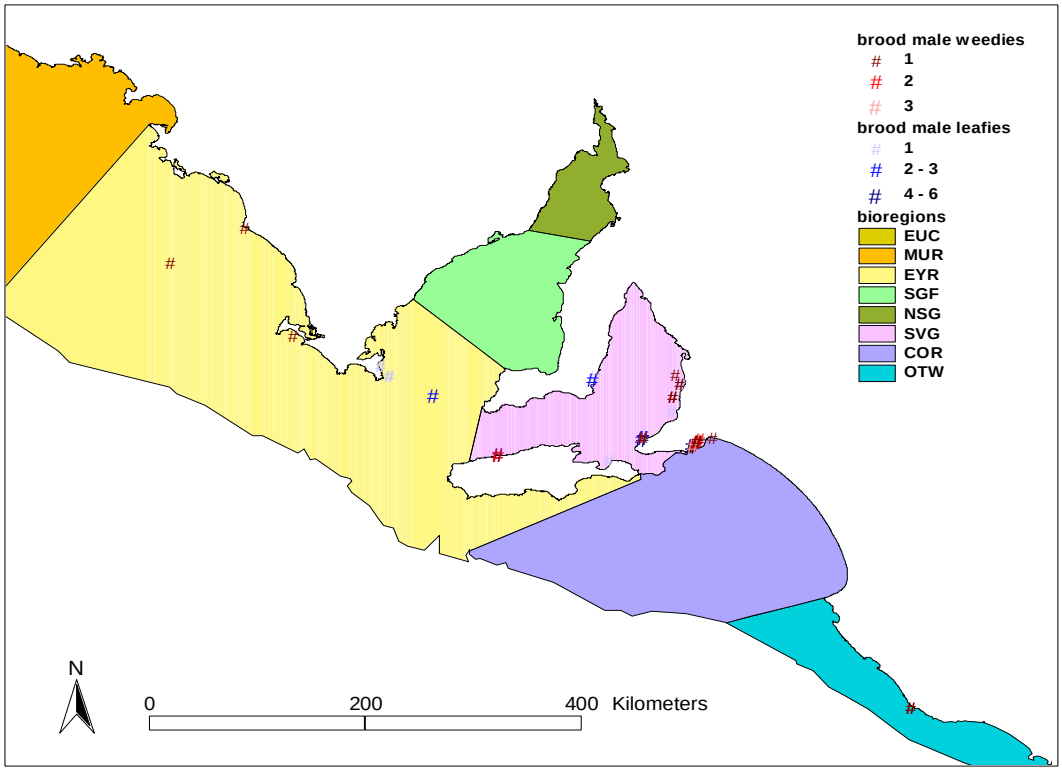
Map 2c: Seadragon sightings in Victorian bioregions, June 1995 to April 2005.



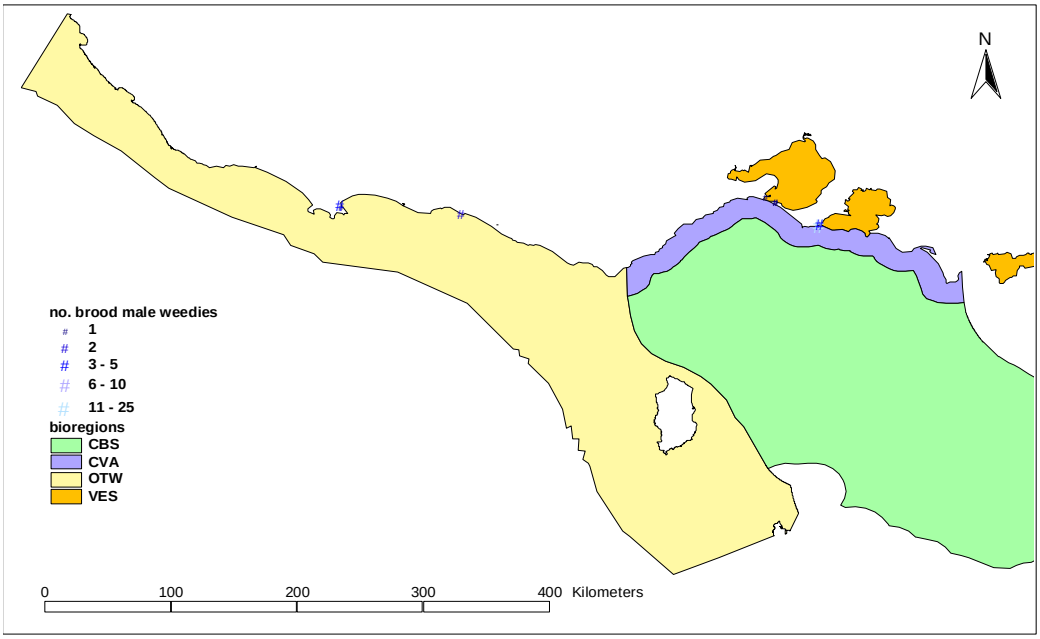
Map 2d: Seadragon sightings in Tasmanian bioregions, April 1990 to April 2005.



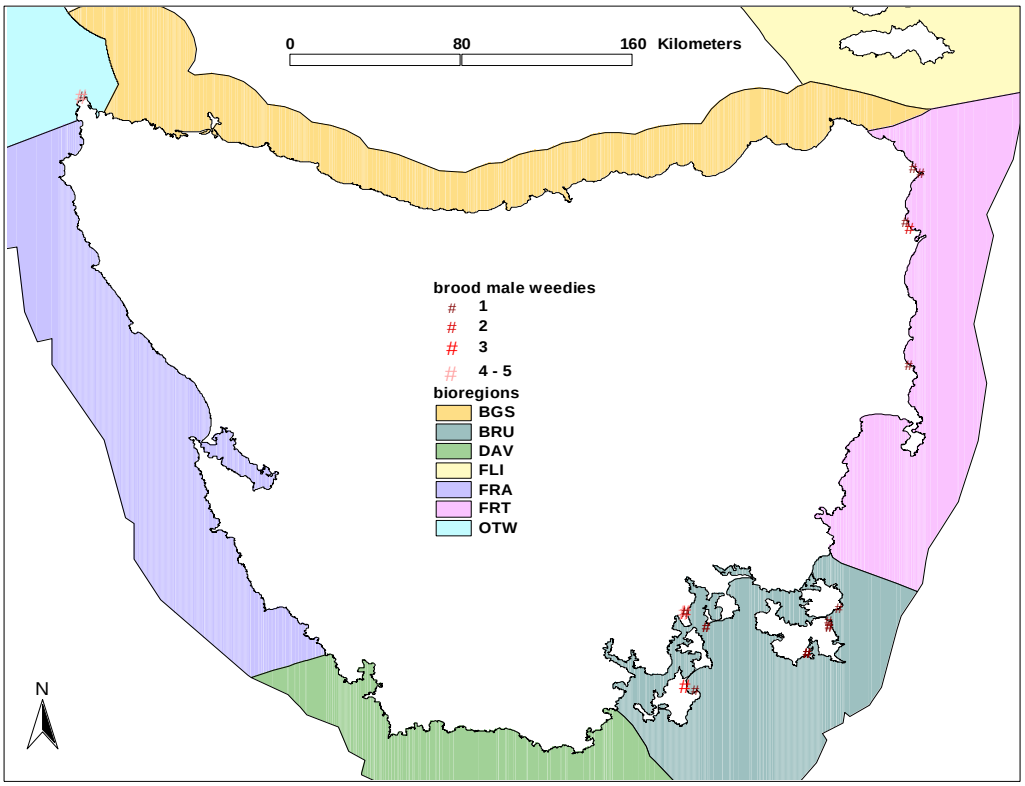
Map 3a: Numbers of brood male weedy and leafy seadragons sighted in Western Australian bioregions, July 1990 to April 2005



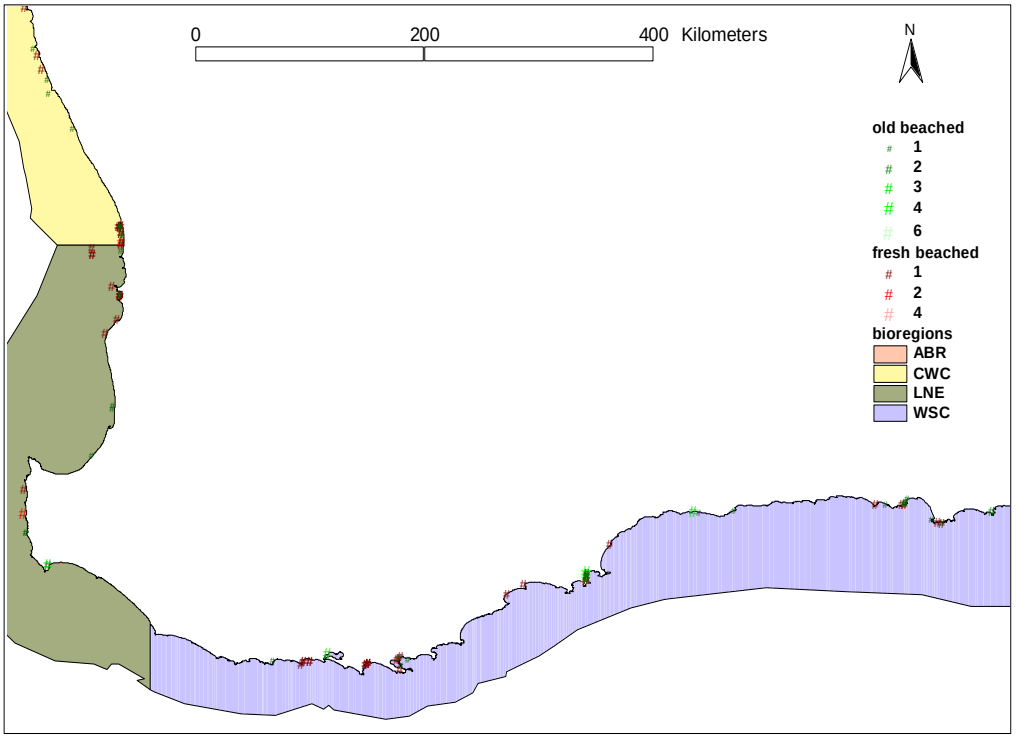
Map 3b: Numbers of brood male weedy and leafy seadragons sighted in South Australian bioregions, January 1990 to May 2005



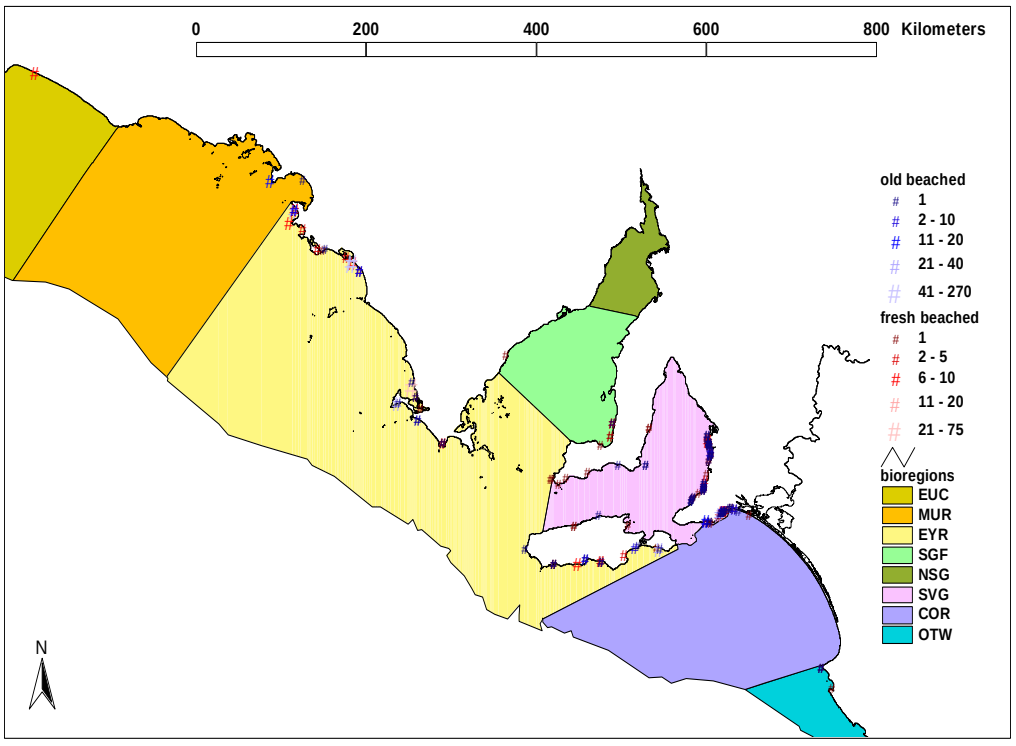
Map 3c: Numbers of brood male weedy seadragons sighted in Victorian bioregions, June 1995 to April 2005.



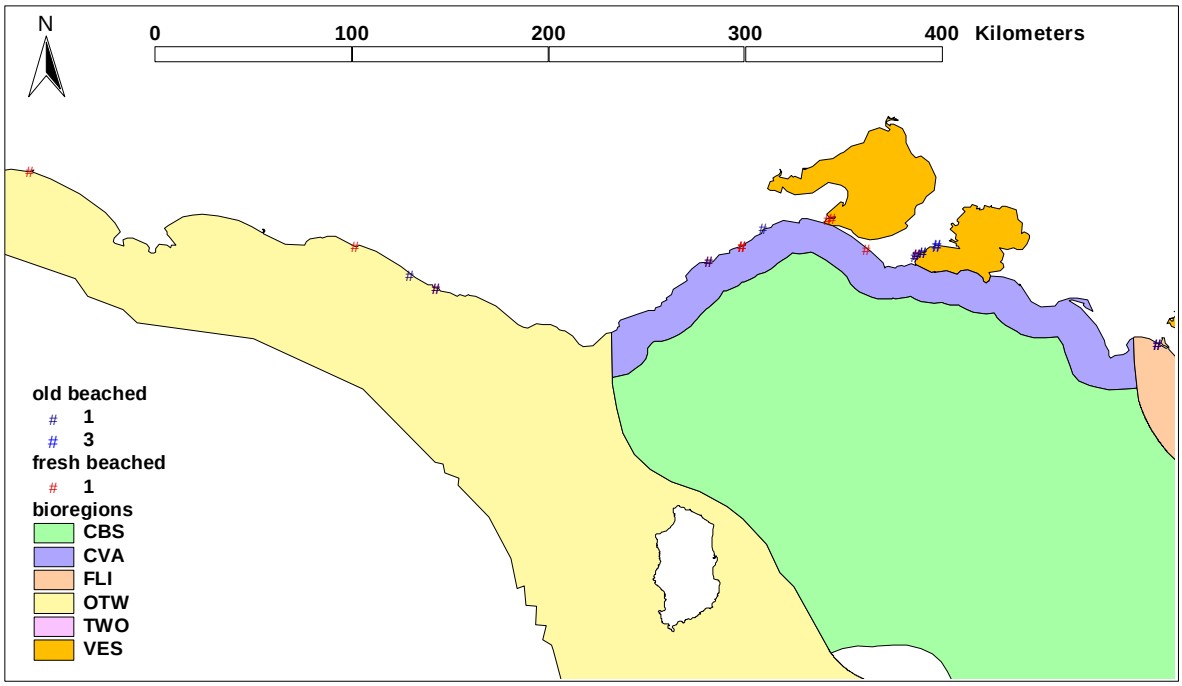
Map 3d: Numbers of brood male weedy seadragons sighted in Tasmanian bioregions, April 1990 to April 2005.



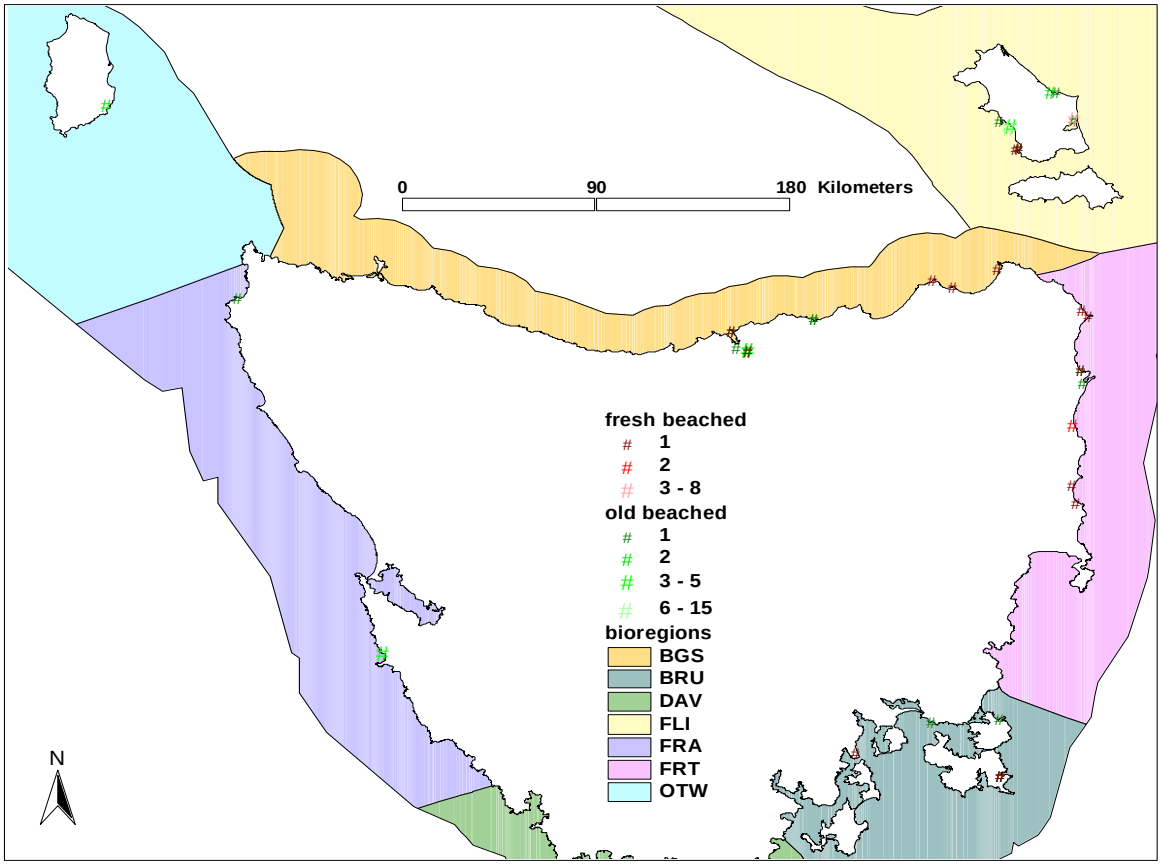
Map 4a: Distribution of beachwashed seadragon sightings in Western Australia, July 1990 to April 2005



Map 4b: Distribution of beachwashed seadragon sightings in South Australia, January 1990 to May 2005



Map 4c: Distribution of beachwashed seadragon sightings in Victoria, June 1995 to April 2005



Map 4d: Distribution of beachwashed seadragon sightings in Tasmania, April 1990 to April 2005.