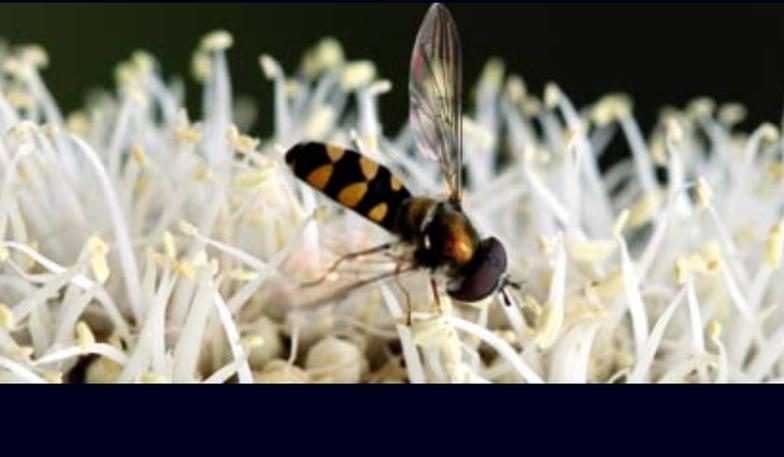


# Invertebrates



## Hemichordata (hemichordates)

Burdon-Jones (1998) stated that there are 94 described species in 16 genera in the world, with many more undescribed, and 12 species in seven genera in Australia. Cameron (2008) lists 108 species for the world in three Classes, seven families and 18 genera. This is an increase of two over his 2004 list cited in the previous report. Groombridge and Jenkins (2002) reported c. 90 or 100 species, whereas Brusca and Brusca (2003) gave only 85 species and Bouchet (2006) gave 106.

DEH (2007) lists 17 species for Australia with an estimated 22 species in total. It would appear from the treatment by Burdon-Jones (1998) that at least three species are endemic to Australia. I have accepted the most recent figures of 108 for the world (Cameron 2008) and 17(22) (DEH 2007) for Australia. The Australian numbers have not increased since the previous report.

There are no listed threatened species for Australia (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>38</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
85	108	108	~110	17	15.7%	22	~25%	0	0	–

38 The IUCN Red List of Threatened Species (2009b).

## Echinodermata (starfish, sea cucumbers, etc)

Estimates of the number of described echinoderms in the world vary from about 6,100 (Tangley 1997, Miyajima 2002) through 6,600 (Mooi pers. comm.<sup>40</sup>) to 7,000 (Wray 1999, Groombridge and Jenkins 2002, Brusca and Brusca 2003, Mulcrone 2005, Bouchet 2006). Charles Messing's Crinoid Web (Messing n.dat.) lists 540 for comatulids and ~95 species of stalked crinoids giving a total of ~635 species for Crinoidea. The *World Asteroidea database* (Mah 2009) gives a current figure of 1,859 species for the Asteroidea. The *World Ophiuroidea database* (Stöhr and O'Hara 2007) provides a figure of 2,139 for the Ophiuroidea. Follo and Fautin (2001) cited 940 for Echinoidea. The *Tree of Life* (Ker 2000), in a breakdown of Orders, listed 1,430 species of Holothuroidea—I have found no more recent definitive figures. Adding these figures up gives a total of 7,003.

Estimating the total number of species is a difficult exercise. The main problems appear to be the unknown species of the deep waters, the difficulty in finding and identifying very cryptic species and the enormous potential of molecular studies to 'discover' new species<sup>39</sup>. The figure

here is estimated by doubling known numbers for most Classes, and adding an extra 20–25% for the Ophiuroidea and Holothuroidea which are 'cryptic, diverse, relatively unstudied, and common in the deep sea'<sup>40</sup>.

The number of Australian described species is placed at around 1,475 (O'Hara pers. comm. 2009<sup>41</sup>). The *Australian Faunal Directory* (ABRS 2009a) and others (Ponder *et al.* 2002) predict that there may be up to 2,000 species in Australian waters. O'Hara (pers. comm.) states that the number of species in the Australian Economic Exclusion Zone is still a large unknown. I have seen estimates of endemism in Australia as high as 90% for southern waters and 15% for tropical waters (Ponder *et al.* 2002), but working through the currently published species (Rowe and Gates 1995), the figure comes out at around 31% for Australia as a whole.

There are no listed threatened species.



World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>42</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
6,100	7,003	7,003	~14,000	1,475	21.1%	~2,000	31%	0	0	–

<sup>39</sup> pers. comm. Rich Mooi, California Academy of Sciences, 17 June 2005 and 16 March 2009.

<sup>40</sup> pers. comm. Rich Mooi, California Academy of Sciences, 17 June 2005.

<sup>41</sup> pers. comm. Tim O'Hara, Museum of Victoria, March 2009.

<sup>42</sup> The IUCN Red List of Threatened Species (2009b), but note that they do list one 'Near Threatened' species.



## Insecta (insects)

Estimates of the number of described insects in the world vary from about 720,000 (May 2000) through 751,000 (Tangley 1997), 800,000 (Nieuwenhuys 1998, 2008), 948,000 (Brusca and Brusca 2003), 950,000 (IUCN 2004) to more than 1 million (Myers 2001a). Groombridge and Jenkins (2002) provide the figure of 963,000 for insects plus myriapods. Estimates for the total numbers of insects vary widely from around 2 million (Nielsen and Mound 2000), 5–6 million (Raven and Yeates 2007) to around 8 million (Hammond 1995, Groombridge and Jenkins 2002). Calculations based on extrapolations from species of Coleoptera and Lepidoptera in New Guinea by Novotny *et al.* (2002) produced a figure of between 3.7 and 5.9 million for the total number of arthropods in the world. Some workers

have estimated that there could be as many as 100 million beetles alone (Tangley 1997), but this would appear to be a gross over-estimate. In the table below, I have attempted to document the numbers for each of the Orders. This leads to a figure between 965,000 and 1,015,000 so I have adopted a figure here of ~1 million as a mid point. This is consistent with previous estimates, but a little higher than the previous report for the number of described species for the world. I have been unable to get individual estimates for the total number of species by Order except for a few Orders, and have thus accepted the figure of about 5 million as given by Grimaldi and Engel (2005) and Raven and Yeates (2007). This is higher than the 4 million given in the previous report which was based on May (2000). As stated by Miller *et al.* (2002):

*'Current evidence from the major museum collections of sorted and labeled insect species, whether described or undescribed, does not support larger estimates, and*

*insect taxonomists broadly concur from this that although there may be up to five million species of insect in the world, there are probably less than 10 million (Nielsen and Mound 2000).'*

Based on the table below, the number of described species in Australia would appear to be around 62,000 with the total number of species varying from about 195,000 to 215,000. I have accepted the figure of nearly 205,000 given by Yeates *et al.* (2003) and Raven and Yeates (2007). The difference between the numbers is due to the variation in estimates for Coleoptera of 80,000 and 100,000 (Yeates *et al.* 2003).

Little appears to have been written on endemism in Australian insects, however Ridsdill-Smith (2004) stated that *'up to 70% of insects are endemic to Australia.'*

There are eight listed threatened species of insect in Australia and one undescribed subspecies. Three are listed as Critically Endangered, four as Endangered, and one as Vulnerable with the subspecies listed as Endangered (DEWHA 2009a).



## Insecta (insects) *continued*

Order	World Descr./ Accepted	Reference	World Estimate	Australia Descr./ Accepted	Reference	Australia Estimate	Reference
Archaeognatha	470	Hallan (2003)		10	ABRS (2009a)	14	Yeates <i>et al.</i> (2003)
Blattodea	3,684–4,000	Hallan (2003), ABRS (2009a)		534	ABRS (2009a)	587	Yeates <i>et al.</i> (2003)
Coleoptera	360,000–~400,000	CSIRO <sup>43</sup> , Oberprieler <sup>44</sup>	1,100,000	22,901	Yeates <i>et al.</i> (2003)	80,000–100,000	Yeates <i>et al.</i> (2003), Oberprieler <sup>45</sup>
Dermoptera	1,816	Hallan (2003)		91	ABRS (2009a)	121	Yeates <i>et al.</i> (2003)
Diptera	152,956	Thompson 2008	240,000 <sup>46</sup>	7,482	ABRS (2009a)	30,000	Yeates <i>et al.</i> (2003), Austin <i>et al.</i> (2004)
Embioptera	200–300	ABRS (2009a), Wikipedia <sup>47</sup>	2,000	26	ABRS (2009a)	28	Yeates <i>et al.</i> (2003)
Ephemeroptera	2,500–<3,000	Wikipedia <sup>48</sup> , ABRS (2009a)		113	ABRS (2009a)	333	Yeates <i>et al.</i> (2003)
Grylloblattaria	24	Hallan (2003)		0		0	
Hemiptera	80,000–88,000	Discover Life <sup>49</sup> , Hallan (2003)		5,150–~6,000	ABRS (2009a)	11,580	Yeates <i>et al.</i> (2003)
Hymenoptera	115,000	Hymenoptera Online Database <sup>50</sup>	>300,000	9,155	ABRS (2009a)	44,000	Yeates <i>et al.</i> (2003), Austin <i>et al.</i> (2004)
Isoptera	2,600–2,800	Wikipedia <sup>51</sup> , Hallan (2003)	4,000 <sup>51</sup>	263 <sup>52</sup>	ABRS (2009a)	455	Yeates <i>et al.</i> (2003)
Lepidoptera	174,250	Lepidoptera Taxome Project <sup>53</sup>	300,000–500,000 <sup>54</sup>	10,586	Yeates <i>et al.</i> (2003)	20,000	Yeates <i>et al.</i> (2003)
Mantodea	2,200	Encyclopedia Britannica <sup>55</sup>		105	ABRS (2009a)	114–160	Yeates <i>et al.</i> (2003), ABRS (2009a)
Mecoptera	481	Hallan (2003)		30	ABRS (2009a)	30	Yeates <i>et al.</i> (2003)
Megaloptera	250–300	Hallan (2003), ABRS (2009a)		26	ABRS (2009a)	26	Yeates <i>et al.</i> (2003)
Neuroptera	~5,000	ABRS (2009a)		553–>600	ABRS (2009a)	800	Yeates <i>et al.</i> (2003)
Odonata	6,500	Trueman & Rowe (2008)		321	ABRS (2009a)	330	Yeates <i>et al.</i> (2003)
Orthoptera	24,380	Eades & Otte (2009)		1,835	Yeates <i>et al.</i> (2003)	2,800	Yeates <i>et al.</i> (2003)
Phasmatodea (Phasmida)	2,500 <sup>56</sup> –3,300	ABRS (2009a), Hallan (2003)		105	ABRS (2009a)	115–150	Yeates <i>et al.</i> (2003), ABRS (2009a)
Phthiraptera	>3,000–~3,200	Smith & Page (1997), ABRS (2009a)		465	ABRS (2009a)	648	Yeates <i>et al.</i> (2003)
Plecoptera	2,274	Hallan (2003)		192	ABRS (2009a)	196	Yeates <i>et al.</i> (2003)
Psocoptera	3,200–~3,500	Hallan (2003), ABRS (2009a)		293	ABRS (2009a)	293 plus many more	ABRS (2009a)
Siphonaptera	2,525	ABRS (2009a)		84	ABRS (2009a)	92	Yeates <i>et al.</i> (2003)
Strepsiptera	596	Kathirithamby (2002)		42	ABRS (2009a)	58–159	Yeates <i>et al.</i> (2003), ABRS (2009a)
Thysanoptera	~6,000	ABRS (2009a)		750	ABRS (2009a)	~1500	ABRS (2009a)
Trichoptera	12,627	Trichoptera World Checklist <sup>57</sup>		719	ABRS (2009a)	800	Yeates <i>et al.</i> (2003)
Zoraptera	28	Hallan (2003)		1	ABRS (2009a) <sup>58</sup>	1	–
Zygentoma (Thysanura)	370	Mendes (2002)		36	ABRS (2009a)	38	Yeates <i>et al.</i> (2003)
TOTAL	965,431–1,015,897			61,868–62,765		~194,959–215,141	



World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>59</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
720,000	>1,000,000	~1,000,000	~5,000,000	~62,000	6.2%	~205,000	up to 70%	626 (0.06%)	8 (0.01%)	1.2%

43 CSIRO: Beetle Research. <http://www.csiro.au/science/Beetle-Research.html> [Accessed 18 March 2009].

44 Oberprieler *et al.* (2007) and pers. comm., November 2008. Oberprieler's figures included 62,000 and 220,000 for the number of described and estimated species of Curculionoidea weevils respectively with 4,188 described for Australia out of an estimated 20,000 species.

45 Oberprieler *et al.* (2007) and pers. comm., November 2008.

46 *Wikipedia* (2009): Diptera. <http://en.wikipedia.org/wiki/Diptera> [Accessed 18 March 2009].

47 *Wikipedia* (2009): Embioptera. <http://en.wikipedia.org/wiki/Embioptera> [Accessed 18 March 2009].

48 *Wikipedia* (2009): Ephemeroptera. <http://en.wikipedia.org/wiki/Mayfly> [Accessed 18 March 2009].

49 *Discover Life* (2009): Hemiptera. <http://www.discoverlife.org/mp/20o?search=Hemiptera> [Accessed 18 March 2009].

50 *Hymenoptera Online Database* <http://osuc.biosci.ohio-state.edu/HymOnline/> [Accessed on 18 March 2009].

51 *Wikipedia* (2009): Termite. <http://en.wikipedia.org/wiki/Termite> [Accessed 18 March 2009].

52 At least 348 species now recognised, but many as yet to be formally described (ABRS 2009a).

53 *Taxonomy of the Lepidoptera: the scale of the problem*. <http://www.ucl.ac.uk/taxome/lepnos.html> [Accessed 18 March 2009].

54 *Moth and butterfly (Lepidoptera). research at CSIRO* <http://www.csiro.au/science/ps1e7.html> [Accessed 18 March 2009].

55 *Encyclopedia Britannica* <http://www.britannica.com/EBchecked/topic/362942/mantid> [Accessed 18 March 2009].

56 Many species may have been described twice as males and females can be vastly different (Kevan 1982 from ABRS 2009a).

57 *Trichoptera World Checklist* <http://entweb.clemson.edu/database/trichopt/> [Accessed 18 March 2009].

58 The one species described for Australia occurs only on Christmas Island.

59 The IUCN Red List of Threatened Species (2009b).

## Arachnida (spiders, scorpions, etc)

Estimates of the number of described arachnids vary from 60,000 (Myers 2001a, Brusca and Brusca 2003) through 70,000 species (Nieuwenhuys 1999), 74,000 (Groombridge and Jenkins 2002), 75,000 (Hawksworth and Kalin-Arroyo 1995, May 2000), 98,000 (Chapman 2006) to 102,248 (this report). There do not seem to be many estimates for the total numbers of spiders in the world, however Coddington and Levi (1991) predicted that there may be as many as 170,000 species. Perhaps the best way to determine the number of described arachnid species is to make a breakdown of the various Orders. Spiders are probably the best known, and Nieuwenhuys (2008) gives 40,462 species while Platnick (2008) lists 40,700 described species in *The World Spider Catalog*. One of the largest of the arachnid groups includes the mites and ticks (Acarina) and here the numbers vary greatly. Hickman *et al.* (2004) estimated 40,000 described species with a total of 500,000 to 1 million. Halliday *et al.* (2000) estimated that there were 48,200 described species of Acarina and a total fauna of about 0.5 million. Walter *et al.* (1996) on the *Tree of Life* website estimated 45,000 described species and suggested that that may only be about 5% of the total species alive today. Other estimates from the 1960s and 1970s (see Halliday *et al.* 2000) varied from 17,500 to 30,000. Other Orders include Amblypygi (136 (Harvey 2003)), Opiliones (around 5,000 species (Myers 2001a), 6,400 (Pinto-da-Rocha *et al.* 2007)), Palpigradi (c. 78 (Harvey 2003), to 80 species<sup>60</sup>),

Pseudoscorpionida (>3,300 species<sup>61</sup>), Ricinulei (57 species (Amrine 2005)), Schizomida (>230<sup>62</sup>), Scorpionida (1,764 (Rein 2009)), Solifugae (1,095 (Savary 2006)) and Uropygi (286 (Fox 2006)). Summation of these figures gives a total of over 102,248 described species, considerably higher than the estimates cited above, with estimates of the total number of species varying between 160,000 and about 1 million (Hawksworth and Kalin-Arroyo 1995). Hawksworth and Kalin-Arroyo (1995) accepted a working figure of 750,000 species.

Halliday *et al.* (2000) conducted an extensive literature survey of mites in Australia and concluded that there were about 2,700 described species and by extrapolating from recent revisions estimated that the total mite fauna in Australia may be in the order of 7,800. They then further suggested that this may be a gross under-estimation as many of the lesser known groups are likely to include many more species. Their final estimate for the total Australian mite species was in excess of 20,000 species.

ABRS (ABRS 2009a) reports numbers of described and estimated Australian species as shown in the following table, except for the number of 10,000 for the estimated Araneae which comes from Raven (pers. comm.<sup>63</sup>) who stated that the figure of 20,000 in Yeates *et al.* (2003) was a gross over-estimate. Raven also supplied an updated figure of 3,300 for

the number of described species of Araneae. Estimates for the total number of the described Australian Arachnid fauna varies from 5,666 (DEH 2001) through 5,711 (DEH 2007) to 6,615 (this publication) and for the total number of Arachnid fauna from 20,937 (using Halliday's number for the Acarina) through 22,838 (this publication) to 27,837 (using the ABRS figure for the Acarina) and 27,960 (previous report). Harvey (pers. comm.<sup>64</sup>) agrees that this is a good summary of current knowledge. No estimates of the percentage of Australian endemics has been found.

There are no species of spider listed as threatened for Australia (DEWHA 2009a).



60 *Wikipedia* (2000): Palpigradi. <http://en.wikipedia.org/wiki/Palpigradi> [Accessed 23 March 2009].

61 *Wikipedia* (2000): Pseudoscorpion. <http://en.wikipedia.org/wiki/Pseudoscorpiones> [Accessed 23 March 2009].

62 *Wikipedia* (2005): Schizomida. <http://en.wikipedia.org/wiki/Schizomida> [Accessed 23 March 2009].



Order	World Described	World Estimated	Australian Described	Australian Estimated
Acarina	48,200	~100,000–500,000	2,851	20,000
Amblypygi	136	150	5	10
Araneae	40,700	80,000 <sup>65</sup>	3,300	10,000
Opiliones	6,400	10,000	199	500
Palpigradi	<80	unknown	3	3
Pseudoscorpionida	~3,300	unknown	161	600
Ricinulei	57	unknown	0	0
Scorpionida	1,764	~2,400	43	150
Schizomida	>230	unknown	53	75
Solifugae	1,095	unknown	0	0
Uropygi	286	unknown	0	0
TOTAL	~102,248	~200,000–600,000	6,615	31,338



World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>66</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
60,000	102,248	102,248	200,000–600,000	6,615	6.5%	31,338	unknown	18 (0.02%)	0	0%

63 pers. comm. Robert Raven, Queensland Museum, March 2009.

64 pers. comm. Mark Harvey, Western Australian Museum, July 2009. With reference to Harvey (2002), Harvey (2007), Harvey (2009).

65 Raven and Yeates (2007) reporting a pers. comm. from N.I. Platnick (2004).

66 The IUCN Red List of Threatened Species (2009b).

## Pycnogonida (sea spiders)

There are around 1,340 described species of Pycnogonida in the world (Arango pers. comm.<sup>67</sup>). Bamber and Nagar (2009) list 1,308 species (as of early April 2009), but this does not include the recently described Australian species.

A recent study by Arango at the Queensland Museum (Arango pers. comm.<sup>67</sup>) has identified 215 species for Australia, and predicts that this number will increase rapidly with many newly discovered species. Examining the species listed in the *Australian Faunal Directory* (ABRS 2009a),

just under 50% are identified as endemic. This figure will increase with the addition of the newly described species.

No species are identified as threatened in Australia at this stage (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>68</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
1,300	1,340	1,340	unknown	215	16.0%	unknown	~50%	0	0	–

67 pers. comm. Claudio Arango, Queensland Museum, April 2009.

68 The IUCN Red List of Threatened Species (2009b).



## Myriapoda (millipedes, centipedes)

Brusca and Brusca (2003) gave an estimate of 11,460 described species of Myriapoda in the world.

Yeates *et al.* (2003) estimated the total number of described myriapod species in Australia at 2,539. This is lower than the ABRS estimate of 2,800 (DEH 2007).

There are no myriapod species listed as threatened in Australia (DEWHA 2009a).



### Chilopoda (centipedes)

Estimates of the number of described species of Chilopoda vary from 2,500 (Hoffman 1982, Myers 2001c) through 2,800 (Brusca and Brusca 2003) to about 5,000 (Nieuwenhuys 2008). I have accepted the figure of 3,149 in 429 genera for the world as cited in *Chilobase* (Bonato *et al.* 2006). ABRS (2009a) lists 131 species of Chilopoda for Australia and a number have been added recently (Edgecombe pers. comm.<sup>69</sup>). Yeates *et al.* (2003) provided an estimate of about 446 for total species in Australia. Calculations from ABRS (2009a) and Edgecombe (pers. comm.<sup>69</sup>) lead to a figure of around 81.4% endemism.

### Diplopoda (millipedes)

Estimates of the number of described species of Diplopoda vary from 5,000 (Nieuwenhuys 2008) through 8,000 (Myers 2001b, Brusca and Brusca 2003), 10,000 (Geoffroy 2001) to 12,000 (Sierwald and Bond 2007). I have accepted the figure of 12,000 as given by Sierwald and Bond (2007) as this appears to be 'very solid' (Mesibov pers. comm.<sup>70</sup>). Geoffroy (2001) estimated the total number of species at between 80,000 and 90,000. These figures appear to be based on Hoffman (1980) and are regarded as probably an under-estimate (Mesibov pers. comm.<sup>70</sup>). Mesibov (2008 and pers. comm.<sup>70</sup>) provides figures of 366 species for Australia and an estimate of around 2,000 in total. Endemism in the 230 species listed in ABRS (2009a) is 91.3%.

### Pauropoda (centipede-like arthropods)

The number of described Pauropoda of the world is between 500 (Brusca and Brusca 2003) and 715 (ABRS 2009a), with 18 species described for Australia (55% of which are endemic), but with an estimated total number of >500 (ABRS 2009a). I have accepted the ABRS figure of 715 for the world.

### Symphyla (glasshouse symphylans)

Although little information could be obtained on this group, it would appear that there are about 200 described species of Symphyla in the world (ABRS 2009a). Brusca and Brusca (2003) estimated that there are 160 species and Hallan (2003) gave 208 species.

ABRS (2009a) listed 26 species for Australia, of which 24 are endemic, and estimates about 150 species in total. Yeates *et al.* (2003) provided a figure of 29 described species with 200 for the total number of species.

69 pers. comm. Greg Edgecombe, Natural History Museum, London, UK, March 2009.

70 pers. comm. Bob Mesibov, Queen Victoria Museum and Art Gallery, Launceston, Tasmania, March 2009.

## Myriapoda (millipedes, centipedes) *continued*

	World Desc./ Accepted min.	World Desc./ Accepted max.	World Desc./ Accepted	World Estimate	Australia Desc./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>71</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
Chilopoda	2,500	5,000	3,149	unknown	140	4.0%	446	81.4%		0	
Diplopoda	5,000	12,000	12,000	80,000–90,000	366	2.9%	2,000	91.3%		0	
Paupoda	500	715	715	unknown	18	2.5%	>500	55.5%		0	
Symphyla	160	208	208	unknown	29	13.9%	150	92.3%		0	
<b>Total</b>	<b>8,160</b>	<b>17,923</b>	<b>16,072</b>	<b>~90,000</b>	<b>553</b>	<b>3.4%</b>	<b>~3,100</b>	<b>86.0%</b>	<b>15 (0.1%)</b>	<b>0</b>	<b>0%</b>

71 The IUCN Red List of Threatened Species (2009b).



## Crustacea (crabs, lobsters, etc)



The estimated number of described species of Crustacea in the world varies from 25,000 (Nieuwenhuys 2008), 30,000 (Myers 2001d), >30,000 (Ponder *et al.* 2002), 38,732 (Hallen 2003), 40,000 (with 38,000 marine species) (Hawksworth and Kalin-Arroyo 1995, May 2000, Groombridge and Jenkins 2002), 44,950 marine species (Bouchet 2006), 52,000+ (Martin and Davis 2001, Wikipedia<sup>72</sup>) to 68,171 (Brusca and Brusca 2003). I have accepted a figure of approximately

47,000 described species based on the detailed breakdown given by Bouchet (2006), and adding the approximate 2,000 non-marine species (including 1,608 Ostracoda). One of the big increases since the previous report appears to be with the Ostracoda where Bouchet gives 6,400 marine species plus 1,608 non-marine species as opposed to 5,650 given by Abele (1982) and 10,000–15,000 by Martin and Davis (2001). The recently published checklist of Brachyuran Crabs (Ng *et al.* 2008) gives a figure of 6,793 (species and subspecies) for the crabs. It would appear, however, that there are very few accepted subspecies in the list so 6,793 is fairly close to the number of species. Wilson (2008) states that there are about 950 described species of freshwater isopod crustaceans with another possible 1,400 species remaining to be described out of a total of about 10,300 in all habitats. Further information on individual taxa can be found in *Crustacea.net* coordinated by the Australian Museum (Lowry *et al.* 1999 onwards). The *World List of Marine, Freshwater and Terrestrial Isopod Crustaceans* lists 5,300 species of marine and freshwater isopod crustaceans from 10,659 names (Schotte *et al.* 2009).

The estimated total number of world species is 150,000 (May 2000, Groombridge and Jenkins 2002) with a range of 75,000 to 200,000 (Hammond 1995, Hawksworth and Kalin-Arroyo 1995). Brusca and Brusca (2003) stated that there could be from 5–10 times the number of described species, giving a figure of 300,000–600,000 for their estimate.

In 2007, DEH gave an estimate 7,130 described species for Australia and a total number of 9,500 species. The number given by ABRS (2009a) is 6,467 excluding barnacles and a further 799 species are now known for the Australian fauna. This brings the total number of accepted described species to 7,266.

Overall endemism is unknown, however a count of the Decapoda produced a figure of 25.9% endemism for Australia; and some 69% of Branchiopoda are endemic.

Nine crustacea are listed as threatened species in Australia—two are listed as Critically Endangered, three as Endangered and four as Vulnerable (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>74</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
25,000	68,171	47,000	150,000	7,266	15.5%	~9,500	unknown	606 (1.3%)	9 (0.1%)	1.5%

72 Wikipedia (2009): Crustacean. <http://en.wikipedia.org/wiki/Crustacean> [Accessed 19 May 2009].

73 pers. comm. Peter Davie, Queensland Museum, March 2009.

74 The IUCN Red List of Threatened Species (2009b).

## Onychophora (velvet worms)

The number of described species of Onychophora would appear to be around 165, with estimates varying from about 70 (Hickman *et al.* 2004), 100 (Groombridge and Jenkins 2002), 110 (Brusca and Brusca 2003, Hallan 2003, Peripatus Web<sup>75</sup>), about 120 (Monge-Najera 2000), 155 (Wikipedia<sup>76</sup>) to about 200 (Geoffroy and Ruhberg 2006). Reid in the *Australian Faunal Directory* (ABRS 2009a) states that there are 75 species in the Peripatidae and 90 in the Peripatopsidae, making a total world described fauna of 165 species. This is the figure I have used here, even though it is considerably higher than many of the other estimates. Estimates for the total fauna include about 200 (Geoffroy 2001), 220 (Brusca and Brusca 2003) and 300 (Wikipedia<sup>84</sup>).

In Australia, ABRS (DEH 2007, ABRS 2009a) estimated that there are about 71 described species with perhaps another nine undescribed species. It appears that all 71 are endemic to Australia (ABRS 2009a).

There are no species of Onychophora listed as threatened for Australia (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>77</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
70	200	165	~220	71	43.0%	~80	100%	9 (5.5%)	0	0%

75 *Peripatus.gen.nz Web site: Onychophora* <http://www.peripatus.gen.nz/Taxa/Arthropoda/Onychophora.html> [Accessed 19 May 2009].

76 *Wikipedia* (2009): Onychophora. <http://en.wikipedia.org/wiki/Onychophora> [Accessed 15 May 2009].

77 The IUCN Red List of Threatened Species (2009b).



## Hexapoda (proturans, springtails)

The three Classes covered here include Protura, Collembola and Diplura. Yeates *et al.* (2003) estimated the total number of species in Australia at between about 2,000 and 3,000, with 382 species described. By far the greatest number of these are the Springtails—Collembola. In the previous report this group was inadvertently omitted.



### Collembola

ABRS (2009a) identifies 357 described species of which about 78 are introduced, and an estimated total fauna of about 2,000 species. Bellinger *et al.* (2009) state that there are about 7,900 described species in the world, however Greenslade (ABRS 2009a) suggests that this figure may include many synonyms. Janssens (pers. comm.<sup>78</sup>), one of the managers of the Website *Collembola.org* (Bellinger *et al.* 2009), suggests a more conservative figure of c. 7,500. Hallan (2003) gives a figure of 6,000 species. Hopkin (1997) suggested the total number of species in the world is about 50,000.

### Diplura

ABRS (2009a) identifies 28 species for Australia and 800 for the world. There is little further information currently available. Yeates *et al.* (2003) gave a figure of 38 for estimated number of species for Australia.

### Protura

Szeptycki (2007) listed 31 described species for Australia one of which appeared dubious, whereas ABRS (2009a) lists 32—four of which are probably introduced. Szeptycki (2007) listed 748 species for the world. Twenty-five of the 31 species listed by Szeptycki (2007) are endemic.

There are no species currently listed as threatened in Australia (DEWHA 2009a).

	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>79</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
Collembola	~7,500	50,000	279	34.7%	~2,000	6.1%	0	0	—
Diplura	800	unknown	28	3.5%	38	92.8%	0	0	—
Protura	748	unknown	31	4.1%	32	80.6%	0	0	—
ALL HEXAPODA	~9,048	52,000	338	3.7%	~2,070	~17.6%	0	0	—

<sup>78</sup> pers. comm. Frans Janssens, *Collembola.org*, University of Antwerp, Belgium, May 2009.

<sup>79</sup> The IUCN Red List of Threatened Species (2009b).

## Mollusca (molluscs, shellfish)



Estimates of the number of described species of molluscs in the world vary from nearly 50,000 living species (Tangley 1997, Hickman *et al.* 2004) through 52,525 marine species (Bouchet 2006), 70,000 (Hawksworth and Kalin-Arroyo 1995), 70,000–75,000 (with possibly more than 100,000) (Groombridge and Jenkins 2002), 81,000 (IUCN 2009b), 93,195 (Brusca and Brusca 2003), 110,000 (Hallan 2003) to 120,000 (Ponder *et al.* 2002). Hawksworth and Kalin-Arroyo (1995), Groombridge and Jenkins (2002) and Rosenberg (pers. comm.<sup>80</sup>) estimated a possible total of around 200,000 species, and May (2000) provided an estimate of about 120,000. I have accepted a figure for the world of c. 85,000 described species based on 52,525 marine (Bouchet 2006), and 24,000 terrestrial molluscs and 7,000 freshwater molluscs (Lydeard *et al.* 2004), with a total world estimate of 200,000 species (Rosenberg pers. comm.<sup>80</sup>).

Estimates for Australia are approximately 8,700 described species out of a total of about 12,250 (DEH 2007).

Endemism of about 90% is reported in the 2001 Australian *State of the Environment Report* (DEH 2001), however Ponder *et al.* (2002) reported that only about 10% of tropical species (i.e. about 2/3 of all Australian species) and 95% of temperate species are endemic, making a total of about 38% endemism.

There are 14 listed threatened mollusc species in Australia (one undescribed) and one undescribed subspecies (DEWHA 2009a). Ten (plus the subspecies) are listed as Critically Endangered and four as Endangered.

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>81</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
50,000	120,000	~85,000	~200,000	~8,700	10.2%	~12,250	38%	978 (1.2%)	14 (0.2%)	1.4%

80 pers. comm. Gary Rosenberg, Academy of Natural Sciences, Philadelphia, Sept. 2008.

81 The IUCN Red List of Threatened Species (2009b).



## Annelida (segmented worms)



Estimates for the number of described species of Annelida in the world vary from 12,000 (Tangley 1997, Bouchet 2006) through 12,070 (Hallan 2003), 13,000 (with only about 8,000 reliable species) (Hutchings and Fauchald 2000), 13,500 (Myers 2001e), 15,000 (May 1998, Hickman *et al.* 2004), c. 16,000 (Groombridge and Jenkins 2002), 16,600 (Brusca and Brusca 2003) to 16,763 (this report). Myers

(2001e) reported about 10,000 species of Polychaeta, 3,000 species of Oligochaeta and about 500 species of Hirudinea, and a total of about 13,500 species. Wilson and Capa (pers. comm.<sup>82</sup>) report around 8,350 species in 1,093 genera for Polychaeta, although figures for a number of families are approximate. The figures I have used are c. 8,432 polychaete species, from Beesley *et al.* (2000) who give a detailed breakdown by family; 147 species of Pogonophora from the *Catalogue of Life* (Bisby *et al.* 2009); 7,684 Oligochaeta from Blakemore (2008 and pers. comm.<sup>86</sup>) and 500 Hirudinea from Myers (2001i)—making a total of 16,763. Glasby (pers. comm.<sup>83</sup>) suggests that higher figures often given for Polychaetes (i.e. around 13,000) are more related to names than species and don't take into account synonymy, whereas the lower figures (around 8,000) are more accurate for the number of species.

An estimate for the total number of species is between 25,000 and 30,000 (Snelgrove *et al.* 1997 as reported by Ponder *et al.* 2002).

According to DEH (2007), the number of described Australian species is about 2,300 out of an estimated total of about 4,230. Adding up the species in each Order, however, gives a figure of about 2,192 made up of 1,139 polychaetes (ABRS 2009a, Wilson and Capa pers. comm.<sup>82</sup>), 22 Myzostomida (ABRS 2009a), 10 Pogonophora (which should now be included in the Polychaete family Siboglinidae<sup>84</sup>, 962 oligochaetes<sup>85</sup> and 59 Hirudinea (ABRS 2009a). Many of these figures do, however, appear to be quite fuzzy. The percentage of endemics is unknown, but it is reported that southern Australia has about 67% endemism (Poore 1995). Blakemore (pers. comm.<sup>86</sup>) states that there are probably around 2,000 endemic species of megadriles in Australia, of which 650 are currently described.

There is one listed threatened worm species in Australia, listed as Vulnerable (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>87</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
12,000	16,763	16,763	25,000–30,000	2,192	13.1%	~4,230	67%	6 (0.04%)	1 (0.05%)	16.7%

82 pers. comm. R.Wilson, Museum of Victoria and M.Capa, Australian Museum—made up of 981 described, 144 known undescribed and 14 Antarctic species, April 2009.

83 pers. comm. Chris Glasby, Museum and Art Gallery of the Northern Territory, Darwin, April 2009.

84 pers. comm. R.Wilson, Museum of Victoria and M.Capa Australian Museum—who state that most of these are probably new, undescribed species, April 2009.

85 650 native (and 75 exotic) (terrestrial) megadriles—ref. Rob Blakemore pers. comm. (2009) and 270 microdriles (ABRS 2009a).

86 pers. comm. Rob Blakemore, Tasmania, Sept. 2008.

87 The IUCN Red List of Threatened Species (2009b).

## Nematoda (nematodes, roundworms)

Estimates for the number of described species of Nematoda vary from around 12,000 (Myers 2001f, Hickman *et al.* 2004) through 20,000 (Hodda 2000), 20,000–25,000 (Groombridge and Jenkins 2002), fewer than 25,000 (Baldwin *et al.* 2000), 25,000 (Hawksworth and Kalin-Arroyo 1995, Brusca and Brusca 2003), over 80,000 of which over 15,000 are parasitic (Wikipedia<sup>88</sup>). Bouchet (2006) accepted a figure of 12,000 for marine species based largely on Hugot *et al.* (2001). Estimates for the total numbers of species, however, are much larger, ranging from 400,000 (Hawksworth and Kalin-Arroyo 1995, Groombridge and Jenkins 2002) through about 500,000 (Myers 2001f, Hickman *et al.* 2004) to 500,000–1 million (Baldwin *et al.* 2000) and 'several

times' their estimate of 25,000 (Brusca and Brusca 2003). Baldwin *et al.* (2000) stated that 'Although 4,000–5,000 marine nematode species have been named and described, full surveys of marine habitats probably will reveal many millions of previously unknown species'. They also provided references to estimates for the total number varying from 100,000 (Hawksworth and Kalin-Arroyo 1995) to as many as 10 million.

Estimates for the numbers of described Australian species vary from 1,200 (ABRS 2005) to about 2,060 (DEH 2007). The current version of the *Australian Faunal Directory* (ABRS 2009a) lists just 358 species, but I am informed that this is very incomplete and includes mostly just the free-

living nematodes. Estimates for the total number of species are around 30,000 (DEH 2007). I have found no published estimates for the percentage of endemics.

There are currently no listed threatened species of nematode in Australia (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>89</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
12,000	>80,000	<25,000	~500,000	~2,060	8.2%	~30,000	unknown	0	0	–

88 Wikipedia (2009): Nematode. <http://en.wikipedia.org/wiki/Nematode> [Accessed 19 May 2009].

89 The IUCN Red List of Threatened Species (2009b).



## Acanthocephala (thorny-headed worms)

Estimates for the number of described species of Acanthocephala in the world vary from more than 500 (Hickman *et al.* 2004), 842 (Hallen 2003), over 1,000 (of which 600 are marine) (Groombridge and Jenkins 2002, Bouchet 2006), 1,100 (Brusca and Brusca 2003) to 1,150 (Wikipedia<sup>90</sup>).

Groombridge and Jenkins (2002) suggested that only a low to moderate proportion of the group is known, suggesting perhaps a total of around 1,500 species.

DEH (2007) reports figures of 56 described species for Australia out of a total of about 160.

There are no listed threatened species of Acanthocephala for Australia (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>91</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
~500	1,150	1,150	~1,500	56	4.9%	~160	unknown	0	0	–

90 *Wikipedia* (2009): Acanthocephala. <http://en.wikipedia.org/wiki/Acanthocephala> [Accessed 19 May 2009].

91 The IUCN Red List of Threatened Species (2009b).

## Platyhelminthes (flat worms)

Estimates for the number of described species of flat worms in the world are around 20,000 (Hawksworth and Kalin-Arroyo 1995, Groombridge and Jenkins 2002, Brusca and Brusca 2003), although Hallan (2003) gives an unsubstantiated figure of 25,000. Myers (2001g) reported 3,000 species of Turbellaria, 9,000 species of Trematoda and 5,000 species of Cestoda, while Ponder *et al.* (2002) provided a figure of 3,000–4,000 Monogenea which would give a total of 20,000–21,000 species. I have accepted the lower of these (20,000) in line with the majority of reports. About 15,000 of these are marine species (Bouchet 2006).

I found one obscure estimate of the total number of species at over 80,000.

Estimates for the number of described Australian species vary from 1,506 (DEH 2001) to 1,593 (DEH 2007) with estimates for total species of around 10,000 (DEH 2007) and 10,806 (DEH 2001) although these estimates appear high (Wells pers. comm.<sup>92</sup>). The *Australian Faunal Directory* (ABRS 2009a) lists just 465 species, however this is very incomplete as not all Classes have been covered. Endemism is likely to be low in parasitic forms in birds, marine fishes

and in free-living marine forms and high in parasites of marsupials, reptiles and frogs, and in free-living freshwater forms (Wells pers. comm.<sup>92</sup>).

There are no listed threatened species of Platyhelminthes, however The IUCN Red List of Threatened Species (IUCN 2009b) lists one Extinct species of Turbellaria.

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>93</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
20,000	25,000	20,000	(~80,000)	1,593	8%	~10,000	unknown	0	0	–

<sup>92</sup> pers. comm. Alice Wells, Australian Biological Resources Study, Canberra, July 2009.

<sup>93</sup> The IUCN Red List of Threatened Species (2009b).



## Cnidaria (jellyfish, sea anenomes, corals)

Estimates for the number of described species of Cnidaria in the world vary from 9,000 (Groombridge and Jenkins 2002, Hickman *et al.* 2004) through 9,500 (Hallan 2003), 9,795 (Bouchet 2006), 10,000 (Groombridge and Jenkins 2002) to 10,000–11,000 (Brusca and Brusca 2003). I have accepted the figure of 9,795 as it appears to be the most thoroughly researched and reliable. I am not sure if these include the Myxozoa, which are included here under the Protoctista and of which there are about 1,200 species (Adl *et al.* 2007). I have accepted that these were most likely not included by Bouchet in his publication.

The number of described Australian species reported varies from 1,270 (DEH 2001) to 1,705 (DEH 2007) with estimates of the total Australian fauna consistent at about

2,200 (DEH 2007), made up of around 1,043 species of Anthozoa, 51 species of Scyphozoa, nine of Cubozoa and perhaps around 600 species of Hydrozoa (Ponder *et al.* 2002), making a total of around 1,705 described species and around 2,200 species in total.

There are no listed threatened species of Cnidaria in Australia (DEWHA 2009a) but 231 Anthozoa and five Hydrozoa are listed in The IUCN Red List of Threatened Species for the world.



World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>94</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
9,000	11,000	9,795	unknown	1,705	17.4%	~2,200	unknown	236 (2.4%)	0	0%

94 The IUCN Red List of Threatened Species (2009b).

## Porifera (sponges)

Estimates for the number of described species of Porifera in the world vary from 5,500 (Myers 2001h, Brusca and Brusca 2003, Bouchet 2006) through 5,000–10,000 (Groombridge and Jenkins 2002), 6,000 (ABRS 2009a), to 10,000 (Hallan 2003, Ramel 2009a). ABRS (2009a) also estimates that the figure of 6,000 described species is perhaps only about one-third of the total number of extant species. I have accepted the figure of 6,000 as given by ABRS (2009b).

Described species in Australia number between 1,320 and 1,476. Hooper and Wiedenmayer (1994) provided figures of 1,320–1,335 with 56% endemic and DEH (2001, 2007) estimated that there were 1,416 described species

in Australia with the total number of species in Australian waters at about 3,500. The *Australian Faunal Directory* (ABRS 2009a) has now updated this figure to 1,476. Ponder *et al.* (2002) stated that about 45% of species on the Great Barrier Reef are endemic.

There are currently no listed threatened Porifera species in Australia (DEWHA 2009a).

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened <sup>95</sup>	Australia Threatened	Australian Threatened as percentage of World Threatened
5,500	10,000	~6,000	~18,000	1,476	24.6%	~3,500	56%	0	0	–

95 The IUCN Red List of Threatened Species (2009b).



## Other Invertebrates

A difficulty in listing this group is determining what belongs here, and what belongs in the Protoctista (see later).

Estimates for the number of described species in the various phyla in the world are given in the next table and are compiled from Groombridge and Jenkins (2002), Brusca and Brusca (2003), Hickman *et al.* (2004) and Bouchet (2006). Those for Australia are from ABRS (2009a) with the exception of the Rotifera supplied by Shiel (pers. comm.<sup>96</sup>). The Phylum Monoblastozoa listed in the following table is, according to Meeûs and Renaud (2002), of doubtful existence, and Hickman *et al.* (2002) stated that the Phylum Chaetognatha was not supported by molecular evidence. They have, however, been included in the table. Guidetti and Bertolani (2005) listed 980 species of tardigrade for the world, of which 147 were marine. Bouchet (2006) stated that there were 212 marine species making a new total of 1,045 species in total.

Information for Australia on Tardigrada (water bears) was supplied by Claxton (pers. comm.<sup>97</sup>). She reported that an

unpublished paper by her and Reinhardt Kristensen listed 46 marine species for Australia in 1998, and that her PhD (submitted in 2004) identified 182 terrestrial species of which 69 have been published in the literature. About 56% of the 182 species are endemic. She suggested that there are at least 500 species in total for Australia.

Most estimates for the world total of described species of Mesozoa are around 90–106, whereas ABRS (2005) stated that there are 100 described species for Australia. I have contacted several researchers around Australia, and all have the view that there is probably no-one in Australia who knows the number of described species in Australia. Similarly, the figure of 100 for the Loricifera reported by Groombridge and Jenkins (2002) does not fit with figures of around 10 reported by other researchers, or 28 supplied by Kristensen (pers. comm.<sup>98</sup>).

Other figures that differ from those given in the cited papers are 1,200 described species out of a worldwide total of 5,000–10,000 in Nemertea (Ponder *et al.* 2002).

Ponder *et al.* (2002) stated that about 87% of the Australian species of Entoprocta are endemic. Other endemism figures are largely determined from ABRS (2009a).

There are two species of Nemertea (ribbon worms) listed as Vulnerable in The IUCN Red List of Threatened Species, but no species are currently listed as threatened in Australia (DEWHA 2009a).

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96 pers. comm. Russell Shiel, University of Adelaide, Nov. 2008.

97 pers. comm. Sandra Claxton, New South Wales, Aug. 2008.

98 pers. comm. Reinhardt Kristensen, University of Copenhagen, June 2009.

## Other Invertebrates *continued*

Phylum	Common name	World				World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic
		Hickman <i>et al.</i>	Brusca and Brusca <sup>99</sup>	Groombridge and Jenkins	Bouchet (marine only)						
Placozoa		1	1	1	–	1	–	0	0	0	0
Monoblastozoa		–	1	–	–	1	–	–	–	–	–
Mesozoa (Rhombozoa, Orthonectida)	mesozoans	accepted?	90	~90	106	106	–	100	94%	100	–
Ctenophora	comb jellies	<100	100	~100	166	166	200	10	6%	60	–
Nemertea (Nemertina)	ribbon worms	650	900	~900	1180–1230	1,200	5,000–10,000	81	7%	281	65%
Rotifera	rotifers	~1,800	1,800	~2,000	50 marine	2,180 <sup>100</sup>	–	683	31%	1,300	45%
Gastrotricha	gastrotrichs	~400	450	~400	390–400	400	–	45	11%	45	–
Kinorhyncha	kynorhinchs	75	150	~150	130	130	–	8	6%	8	–
Nematomorpha	horsehair worms	250	320	~240	5 marine	331 <sup>101</sup>	~2,000	32	10%	32	–
Entoprocta (Kamptozoa)	kamptozoans	150	150	~150	165–170	170	170	16	9%	>16	87%
Gnathostomulida	gnathostomulids	>80	80	~80	97	97	–	8	8%	8	–
Priapulida	priapulans	18	16	17	8 marine	16	–	2	12%	2	–
Loricifera	loriciferans	few	10	~100	18 marine	28 <sup>102</sup>	>100	4	14%	6	50%
Cycliophora	cycliophorans	?1	1	accepted?	1	1	–	0	0	0	–
Sipuncula	peanut worms	~330	320	~150	144	144 <sup>103</sup>	–	48	33%	48	–
Echiura	spoon worms	140	135	~140	176	176	–	13	7%	13	54%
Tardigrada	water bears	300–400	800	~750	212 marine	1,045 <sup>104</sup>	–	112 (228)	11–22%	~500	56%
Phoronida	phoronids	~10	20	16	10	10	–	6	60%	6	–
Ectoprocta (Bryozoa)	moss animals	~4,000	4,500	~4,000	5,700	5,700	~5,000	1,000	18%	~2,500	50%
Brachiopoda	lamp shells	~325	335	~350	550	550	–	58	11%	70	~70%
Pentastomida	tongue worms	~90	~130 <sup>105</sup>	accepted?	–	100	–	10	10%	10	–
Chaetognatha	arrow worms	–	100	~70	121	121	–	19	16%	10	0%
TOTAL		~8,820	~10,409	~9,704	9,229–9,294	12,673	~20,000	2,255–2,371	18.7%	~5,015	unknown

99 Brusca and Brusca (2003) treat the Placozoa, Monoblastozoa, Rhombozoa and Orthonectida as phyla of uncertain relationships.

100 1,570 Monogonata, 461 Bdelloidea (Segers 2008) plus at least 70 (maybe as high as 190) marine species (Russell Shiel pers. comm. 2009). Fontaneto *et al.* (2006) state that 148 species have been found in saltwater only—both marine and inland saltwater lakes. Another species was described in Fontaneto *et al.* (2008).

101 326 freshwater species (Poinar 2008) plus five marine species (Bouchet 2006); and an estimated total of about 2,000 species (Poinar 2008).

102 pers. comm. Reinhardt Kristensen, University of Copenhagen, 8 Aug. 2005, June 2009—includes four species from Australian caves, and two species from waters between Australia and New Caledonia.

103 Bisby *et al.* (2009).

104 Guidetti and Bertolani (2005) list 980 species of which 147 are marine. Bouchet (2006) states that there are 212 marine species, making a new total of 1,045 species.

105 Included under Crustacea.

