Fisheries Scientific Committee

CAM Assessment

Cudgegong Giant Spiny Crayfish
Euastacus vesper

Assessment outcome: CRITICALLY ENDANGERED
Category: IUCN category criteria **B1ab(iii)**

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has assessed ***Euastacus vesper*** (**Cudgegong giant spiny crayfish**) under the Common Assessment Method and has determined that it is eligible to be listed as a **CRITICALLY ENDANGERED SPECIES.**

Species information and status

a) Species: *Euastacus vesper* (Cudgegong giant spiny crayfish)

b) Taxonomy

Euastacus vesper McCormack & Ahyong, 2017, the Cudgegong Giant Spiny Crayfish, is a valid, recognised taxon, and is a species defined in the *Fisheries Management Act* 1994.

It was described by McCormack and Ahyong (2017) based on type specimens collected from the Cudgegong River at Coricudgy Road, New South Wales, and lodged at the Australian Museum, Sydney. Phylogenetic analyses by Shull et al. (2005) and Austin et al. (2022) corroborate *E. vesper* as a distinct taxon.

c) Current conservation status

Jurisdiction	State / Territory in which the species is listed	Date listed or assessed (or N/A)	Listing category
International (IUCN Red List)	Not listed	N/A	N/A
National (EPBC Act)	Not listed	N/A	N/A

National (Australian Society for Fish Biology)	Not listed	N/A	N/A
State / Territory	New South Wales	Not listed	Not listed

d) Description of species

Euastacus vesper (Figure 1) is a large spinose species of *Euastacus* (sensu distinct groups in the genus Euastacus, Coughran 2008). The species has been documented to reach at least 71.6 mm occipital carapace length (OCL: Morgan 1997) and a weight of 176 g (NSW DPI Fisheries, unpublished data; McCormack & Ahyong 2017). Females are believed to reach sexual maturity at approximately 50–55 mm OCL (McCormack & Ahyong 2017).

Euastacus vesper is dorsally green-brown with pale cream or yellow general tubercles, cephalic and cervical spines. The large thoracic spines are very dark green to black and the abdominal spines highlighted in yellow to orange. The first chelae are centrally blue, with white to cream-tipped mesial propodal spines; propodal and dactylar apex generally blue with some specimens displaying unique vivid purple-pink colouration; lateral propodal spines cream or blue. The walking legs are green, tending towards lighter blue-green towards tips. The body is cream to orange ventrally (McCormack & Ahyong 2017).

Euastacus vesper is most easily distinguishable in the field from other large spiny crayfish in the area (i.e., *E. armatus* (Murray crayfish)(von Martens 1866) and *E. spinifer* (giant spiny crayfish) (Heller 1865)) on the basis of colouration and spine patterns. *Euastacus armatus*, which can be sympatric with *E. vesper*, is recognisable by the white abdominal spines and claws (versus dark-green to blue, occasionally purplish in *E. vesper*). *Euastacus spinifer*, the nearest phylogenetic relative, occurs to the immediate east of the range of *E. vesper* (but is not sympatric) often has similar colouration, but can be distinguished by having two instead of three approximately horizontal rows of branchial thoracic spines on the sides of the carapace. The three species also attain a different maximum size: *E. vesper* (max OCL = 71.6 mm), *E. armatus* (max OCL = 174 mm), and *E. spinifer* (max OCL = 117 mm: McCormack & Ahyong 2017).

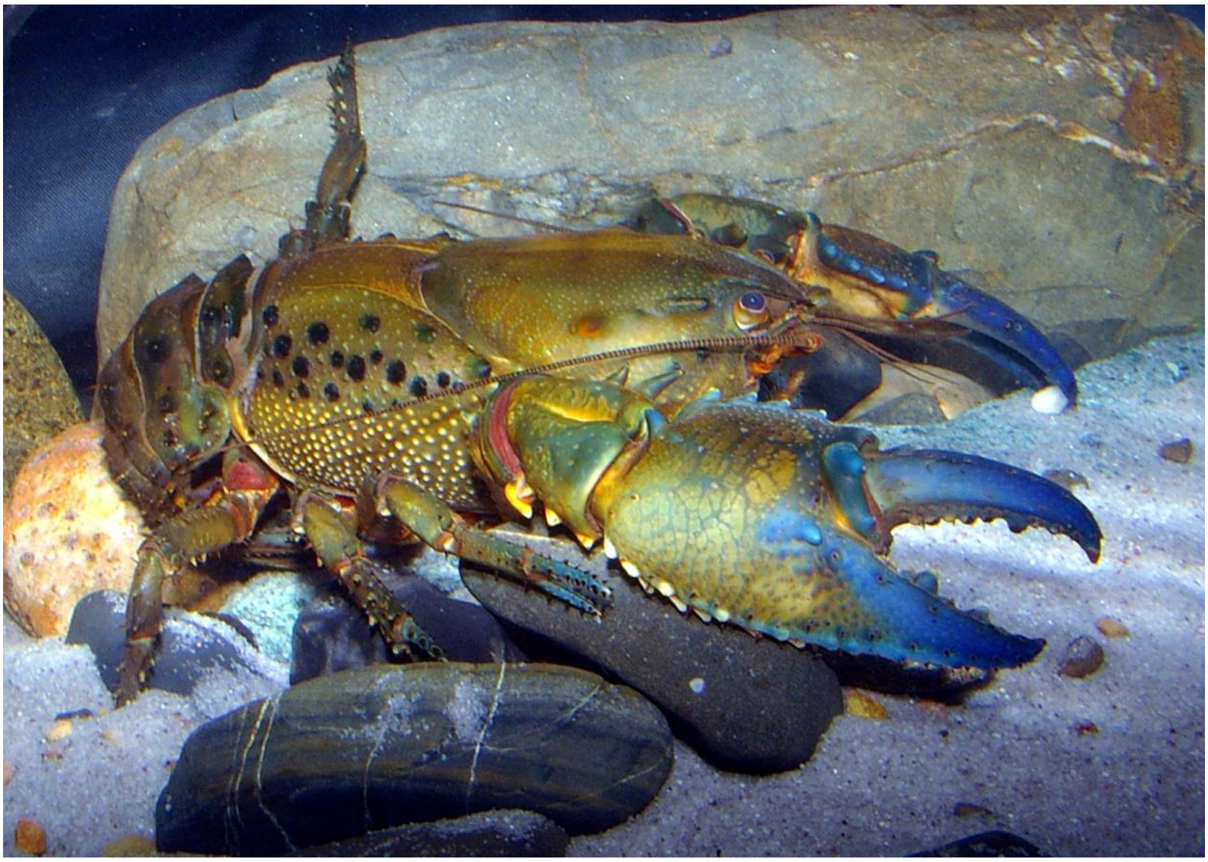

Figure 1. *Euastacus vesper* in a captive setting. Image does not depict the species' natural habitat (McCormack & Ahyong 2017).

e) Distribution of species

Euastacus vesper is known from five sites across a restricted in the upper Macquarie-Bogan Rivers Basin in New South Wales (Figure 2). It has been recorded at altitudes between 743 m and 1123 m above sea level (asl: McCormack & Ahyong 2017). Previous surveys indicate it occurs in the Cudgegong River and its tributaries upstream of Dunns Swamp. There has been limited surveying of the distribution of the species since its description in 2017, so additional sites in the stretch upstream of Dunns Swamp may be identified in the future, but it is not anticipated that EOO and AOO will increase greatly (Rob McCormack 2021, pers. comm).

The Extent of Occurrence (EOO, IUCN 2019) and the Area of Occupancy (AOO, IUCN 2019) of *E. vesper* is 20 km^2 (Figure 1), calculated using GeoCAT (Bachman et al. 2011) (note, calculated EOO = 6.91 m^2).

Part of the range of this species is afforded a degree of protection by being contained within protected areas (Wollemi National Park and Coricudgy State Forest), but these areas are not actively managed for conservation of *E. vesper.*

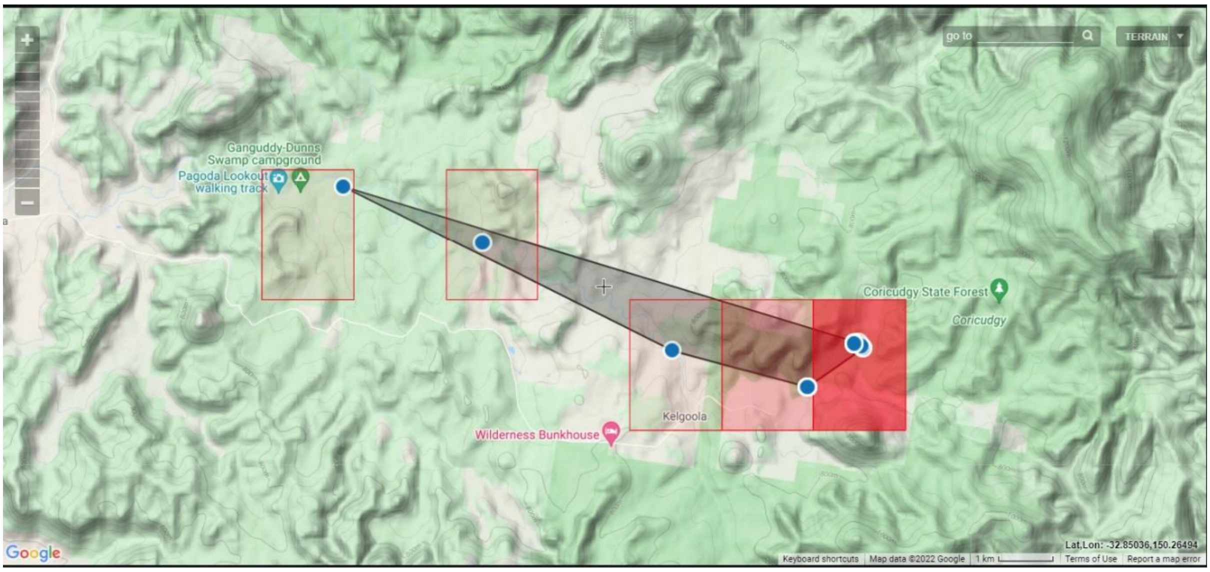

Figure 2. Mapped distribution of *Euastacus vesper,* blue dots denote sites where the species has been collected. Data sources: McCormack and Ahyong (2017), NSW DPI Fisheries, Queensland Museum and. Produced using GeoCAT (Bachman et al. 2011) and Google Earth Pro (provided as a guide, not for broader usage).

f) Relevant biology/ecology of the species

The biology of *E. vesper* is not well known. However, it is recognised that species of *Euastacus* have a suite of common biological characteristics, and many of these characteristics apply to *E. vesper*. Various studies have established that *Euastacus* are slow-growing (growth increments of a few mm OCL yr^{-1}) and long-lived, with some of the other large species in the Euastacus genus taking many decades (35—50 years) to reach full-size (e.g. Honan & Mitchell 1995a, Turvey & Merrick 1997b, Morey 1998, Furse & Wild 2004, Coughran 2013).

Reproductive studies show that *Euastacus* species are typically late maturing and have slow reproductive cycles, with females only reaching reproductive maturity after 5–10 years when they reach a minimum size. It is believed that the onset of maturity in female *E. vesper* is approximately 50–55 mm OCL based on development of external reproductive organs and size of ovigerous females (McCormack & Ahyong 2017), although precise details of reproduction of the species remain unclear. The actual growth rates, population sizes and generation lengths of *E. vesper* are not known.

Many species are winter brooders (mating in late summer/autumn with females carrying eggs over winter) and brooding periods may be long (6–10 months is typical). Some species only breed biennially and pleopodal egg fecundity varies considerably between species, typically ranging from 20–1500 eggs per female (Clark 1937, Barker 1992, Honan & Mitchell 1995b, Turvey & Merrick 1997c, Borsboom 1998, Honan 1998, Morey 1998, Furse & Wild 2004, Coughran 2006, McCormack et al. 2010, Coughran 2013). Few females with eggs ('berried') have been collected in the wild, but fecundity has ranged between 5 and 220 eggs (McCormack & Ahyong 2017).

Dietary studies have not been conducted for *E. vesper*, nor other similar small species of *Euastacus*. In general, freshwater crayfish are opportunistic feeders, and may be both predators and detritivores. The diet of the larger and more widely distributed *E. spinifer* has been studied via analysis of gut contents and field observations, and the species has been found to be an opportunistic omnivore with the majority of the diet composed of woody material (Turvey & Merrick 1997a).

Bone and colleagues established that species of *Euastacus* are susceptible to increasing temperature (Bone et al. 2014, Bone et al. 2017): *E. sulcatus* (mountain crayfish) became sluggish ~23°C and were effectively incapacitated at ~27°C (Bone et al. 2014). Bone et al. (2014) also reported a limited capacity to adapt to higher temperatures in *E. sulcatus*, but that capacity was far too small to provide any confidence that the species could adapt sufficiently to reduce the effects of predicted increases in environmental temperatures (Bone et al. 2014). Lowe et al. (2010) similarly documented a restricted capacity for *E. sulcatus* to physiologically adapt to increasing temperatures. Additionally, faced with conditions of supra-optimal temperatures (e.g. short-term heatwaves, and/or long-term increased environmental temperature) the montane species of *Euastacus* will have little opportunity, if any, for behavioural thermal regulation as stream and burrow waters already provide the coolest refuges in their montane habitats (Bone et al. 2014).

It is not known if smaller or larger specimens (or species) are more, or less, susceptible to the effect(s) of temperature or if the temperature tolerance of more southerly distributed species is different, but the size of the small *E. sulcatus* used in the Bone et al. (2014) study was comparable to that of *E. vesper*.

g) Indigenous significance of the species

Euastacus vesper occurs on the lands of the Wiradjuri people (AIATSIS 2021), but the cultural significance of the species is undocumented. Crayfish, including Euastacus species are known to have been hunted for food in other parts of the country (Koehn & Merrick 1998). It is likely this species was hunted by traditional indigenous hunters.

Given the acknowledged importance to Aboriginal peoples of Connection to Country and the widespread importance of Caring for Country (which includes biodiversity, 'place', custom and totemic elements) it is considered likely that the species has or is associated with some cultural and/or community significance. The significance of the ecological community, particular species, spiritual and other cultural values are diverse and varied for the many Indigenous peoples that live in the area and care for Country. Such knowledge may be only held by Indigenous groups and individuals who are the custodians of this knowledge.

h) Habitat requirements of the species

The habitat requirements of the species are poorly understood. The habitats of the Cudgegong River and its tributary streams where the species is found are perennially flowing and clear with deeper pools (0.5–2 m deep) interspersed with shallow riffles and cascades (McCormack & Ahyong 2017). These habitats occur through both forested areas as well as grazing paddocks with limited canopy and grassy banks (McCormack & Ahyong 2017). It is believed that larger *E. vesper* prefer deeper areas with juveniles found in the shallow margins and under rocks along the side of riffles. Undercut banks with vegetation cover (including *Lomandra* sp.) overhanging the stream edges is also favourable habitat.

Figure 3. Habitat of *E. vesper*, upper Cudgegong River, Coricudgy State Forest, NSW (McCormack & Ahyong 2017).

i) Threats and level of risk to the species

Established threats (habitat destruction, pollution, exotic species, and human exploitation), emerging threats (climate change), and potential future threats (disease such as *Aphanomyces astaci* [crayfish plague]: Panteleit et al. 2017, DAWE 2019) may put nearly all species of *Euastacus* at serious risk of population declines, or extinction, over sub-decadal timeframes (Wells et al. 1983, Furse & Coughran 2011b, Furse 2014, Richman et al. 2015). Climate change is now a key threat to species of *Euastacus*, such as *E. vesper*, due to possessing traits that offer limited capacity to cope with the varied impacts (Furse et al. 2012, Richman et al. 2015, Hossain et al. 2018).

The highly restricted distribution of this species puts all specimens at considerable risk of extirpation, due to the potential of a single stochastic event (e.g., disturbance or disease) impacting the species across its range.

Threat	Extent	Impact
Climate change		
Extreme weather events, including extreme heatwaves	Potentially catastrophic across its entire range	Increased frequency and severity of extreme weather events (heatwaves, storms, droughts) (Coughran & Furse 2010), potentially leading to other localised natural disasters (e.g. landslides and sedimentation events) are broad-scale threats to *E. vesper*. Climate change is projected to increase the severity and frequency of extreme weather events, including heatwaves. By 2020–2039 the Central West and Orana region of NSW is expected to have nine more hot days (over 35°C) annually compared to 1990–2009 (NSW OEH 2014). By 2060–2079 the Central West and Orana region of NSW is expected to have 27 more hot days (over 35°C) annually compared to 1990–2009 (NSW OEH 2014). The habitats of *E. vesper* are anticipated to be impacted by the increase in severity and frequency of extreme heat events. These extreme weather events have the capacity to seriously impact the population, potentially leading to a population decline or extirpation of the species. In addition, a single severe weather event may lead to other localised natural disasters (e.g. flooding, landslides, and sedimentation events (Furse et al. 2012) (see Habitat Loss and Disturbance section below).

Threat	Extent	Impact
Increasing environmental temperature	Potentially catastrophic across its entire range	Increased environmental temperature is a direct, on-going, and persistent long-term impact of climate change. Mean annual temperature is expected to increase in the Central West and Orana region of NSW by 0.7°C in the near future (2020-39) and 2.1°C longer term (2060-79) (NSW OEH 2014). *Euastacus* species are sensitive to increasing environmental temperatures, with the Cudgegong spiny crayfish likely lacking the capacity to physiologically adapt or relocate to cooler habitats as temperatures increase (Lowe et al. 2010, Bone et al. 2015, Bone et al. 2017). This will probably lead to altitudinal compression of habitat as there is limited scope for up-slope migration of this species and overland dispersal to other suitably cool habitats is blocked by the warm lowlands (Furse et al. 2012, Bone et al. 2014). Predicted increases in temperature in the region will impact this species across its range (i.e. the single location) and puts the species at a very high risk of extinction.

Threat	Extent	Impact
Increase in the frequency and severity of drought	Potentially catastrophic across its entire range	*Euastacus* are known to be sensitive to effects of drought, but also effects of flooding (Furse et al. 2012). Moisture deficits and excesses are threats that put this restricted range species at high risk of population declines, or extinction. Changes in the frequence and severity of drought, due to global climate changes, will impact the species itself, but also floral and faunal assemblages, across the species' range. Rainfall patterns in the region occupied by *E. vesper* are predicted to change as a result of climate change, with spring rainfall decreasing and autumn rainfall increasing by 2060–2079 (NSW OEH 2014). Shifting precipitation patterns coupled with projected increases in temperature may lower the local water-table and increase seasonality of streams in which *E. vesper* reside. Overall, this may result in a decrease of available habitat for this species.

Threat	Extent	Impact
Increasing frequency and magnitude of bushfires	Potentially severe across its entire range	The frequency and magnitude of bushfires is predicted to increase under climate change scenarios (Di Virgilio et al. 2019). For the Central West and Orana region of NSW, average fire weather and severe fire weather days are projected to increase during summer and spring in the future (NSW OEH 2014). Impacts may be immediate (habitat loss) or delayed (siltation and deoxygenation of habitat following a fire, change of stream temperature due to canopy loss). It is predicted that 100 % of its range was burnt by the 2019–20 Australian bushfires (NSW FSC, unpublished data; Hyman et al. 2020), but post-fire surveys are warranted to assess the impact. A single bushfire has the capacity to impact the entire population of this restricted range species, potentially leading to a population decline across the species range, or extirpation of the species.
Exotic and invasive species		

Threat	Extent	Impact
Exotic disease *Aphanomyces astaci*	Potentially catastrophic across its entire range	*Aphanomyces astaci* (colloquially, crayfish plague) is a highly contagious pathogen that is uniformly fatal (100% mortality) to susceptible species (e.g., Panteleit et al. 2017); it is one of the world's worst invasive species (Lowe et al. 2000). In Europe and Asia, *A. astaci*, introduced from North America, has decimated populations of native species of freshwater crayfish (Panteleit et al. 2017). *A. astaci* is not currently known in Australia, but has been documented as fatal to Australian freshwater crayfish (Unestam 1975) and the Australian Government is aware of the extremely high risks posed by this disease (DAWE 2019). Increasing illegal wildlife/aquarium trade appreciably increases the risk and probability of *A. astaci* introduction to Australia; this is a most serious threat. A single, illegally-imported crayfish, infected with *A. astaci* has the capacity, via an unlicensed/illegal collector vector (or aquarium discard), to devastate the entire Australian crayfish fauna.

Threat	Extent	Impact
Exotic fishes (and stocking of native species outside of their natural range)	Potentially severe across its entire range	Exotic fishes (and stocking of native species outside of their natural range) present a threat to species of *Euastacus* such as *E. vesper*, through predation and competition (Merrick 1995, Coughran & Furse 2010). Whilst common carp (*Cyprinus carpio*) and redfin perch (*Perca fluviatilis*) are not known from the range of *E. vesper*, other exotic species may be occur. Native species (Murray cod (*Maccullochella peelii*) and golden perch (*Macquaria ambigua*)) are stocked in Cudgegong River (most recently 3000 Murray cod in 2015-16), which is outside of their natural range (NSW DPI Fisheries, stocking database). The translocation of species outside of their natural range is listed as a key threatening process under the Fisheries Management Act 1994 in New South Wales.

Threat	Extent	Impact
Competition with introduced Murray crayfish (*Euastacus armatus*)	Potentially severe across its entire range	Translocation of non-native crayfish or native crayfish outside their natural range, are major threatening process for all species of crayfishes and aquatic ecosystems in Australia (Horwitz 1990, Horwitz 1995, Richman et al. 2015). *Euastacus vesper* co-occur with the translocated Murray crayfish (*E. armatus*) across its range. *Euastacus armatus* appear to occur in higher abundance and in greater biomass (NSW DPI Fisheries, unpublished data), and when larger individuals are present, may have an advantage during agonistic encounters (cf. Hazlett et al. 2007). This competition is likely to negatively impact the abundance, growth and range of *E. vesper*.

Threat	Extent	Impact
Exotic fauna	Potentially severe across its entire range	Feral pigs (*Sus scrofa*) are a threat to species of *Euastacus* (Coughran & Furse 2010, Furse & Coughran 2011a), and occur within in the region. Feral pigs can eat crayfish (Coughran unpublished data) and are a serious threat to burrowing crayfish species, both through predation and their rooting and wallowing behaviour (Furse & Coughran 2011a, DEH 2017). A number of other exotic fauna species are known to occur in the region that are reported to impact crayfish in other regions of Australia and have the capacity to negatively impact the *E. vesper* through predation or habitat disturbance (Feral cat [*Felis catus*], European red fox [*Vulpes vulpes*], Unmanaged goats [*Capra hircus*]) (Coughran & Furse 2010, Furse & Coughran 2011a).

Threat	Extent	Impact
Other exotic diseases	Potentially severe across its entire range	Illegal collectors (see below), and to a lesser extent members of the public, can vector diseases/pathogens between catchments, waterways, and into isolated areas of habitat. In particular, illegal collectors are not subject to the hygiene protocols specified in Scientific Collection permits (see Coughran & Furse 2012). Any accidental introduction of a disease, by any person, has the capacity to eliminate an entire restricted range species such as *E. vesper*, but disease risks from illegal collectors are elevated as they do not operate within regulatory frameworks or abide by their risk minimisation mechanisms. Additionally, illegal collectors are known to move gear and people between many catchments and waterbodies in short periods of time. Illegal collections for personal collections and aquarium trade are known to be increasing, thus increasing the disease risks to this species.

Threat	Extent	Impact
Habitat Loss or Disturbance		
Localised impacts and/or accidents	Potentially moderately to severe across part or its entire range	*Euastacus vesper* occupies relatively remote habitat, far from major population centres. However, National Park campgrounds are nearby, and park tracks are located in vicinity of the species' habitat. Further, part of the range of the species occurs on private property. Given the species' highly restricted range, *E. vesper* is extremely susceptible to any impacts from road accidents (oil/fuel and/or chemical spills from vehicle rollovers), illegal dumping (e.g. chemicals) and from road maintenance or forest management practices (Coughran & Furse 2010). Similar accidents on private property through livestock access and chemical weed spraying may impact the species. A single accident has the capacity to impact parts of, or the entire population of this restricted range species, potentially leading to a population decline or extirpation at a single site, or more broadly across its restricted range.

Threat	Extent	Impact
Exploitation		
Illegal collectors	Potentially severe across parts of the species range	Illegal collectors specifically target rare and decorative species of *Euastacus* for personal collections and the aquarium trade (Coughran 2007, Coughran & Furse 2012; Furse unpublished data). Their targets include species in protected areas (such as national parks) (see Coughran & Furse 2012) and extremely remote areas (Furse unpublished data). A series of these activities are known to have occurred and continue throughout Eastern Australia, with illegally collected crayfish intercepted (outbound) at Australian international airports (Furse unpublished data). Any collection of slow-growing and rare species, such as the *E. vesper*, has capacity to lead to negative population-scale impacts. Specifically, removal of reproductive animals from a population, particularly females that may require >5 years to reach sexual maturity, is likely to seriously impact species' recruitment. Illegal collectors can also act as a vector for diseases/pathogens between catchments, waterways, and into isolated areas of habitat.

Threat	Extent	Impact
Recreational harvest	Potentially moderate across parts of the species range	Whilst all species of *Euastacus* under 90 mm OCL are protected from harvest under the Fisheries Management Act 1994 (DPI 2020), recreational fishers legally harvesting the sympatric common yabby (*Cherax destructor*) could mistakenly harvest of *E. vesper*, which could place pressure on the species.

j) Eligibility against criteria

Assessment against the Criteria

A. Population size reduction

(evidence of decline)

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

ba se

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Category and criteria (or Data Deficient): Insufficient data.

Eligibility against the criteria: There is insufficient data to determine eligibility of *E. vesper* for listing under subcriteria A1, A2 and A4 under Criterion A. The species was only formally described in 2017 and monitoring of population trends has not occurred.

In terms of subcriterion A3, it is projected that there will be a future reduction in population size of *E. vesper* due to the impacts of climate change (NSW OEH 2014); this species and other cool-adapted species of crayfish do not appear to have the capacity to adapt to the current or projected rates of warming. Additionally, a decline in AOO, EOO and quality of habitat is anticipated due to climate change as increasing temperatures and reduced moisture availability displaces flora and fauna upslope, including the rainforest habitat of this species. Severe weather events (heatwaves, droughts), plus bushfires, accidents and impacts from exotic species and disease are likely to further reduce the population size. The species' highly restricted distribution, at one location, leaves it highly vulnerable to extinction from a single stochastic event or disturbance, accident, or other threat. Yet, at this stage, it is concluded that insufficient data exists to assess changes in population size.

B. Geographic range

(EOO and AOO, number of locations and evidence of decline)

Criterion 2.	Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy		
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations;(iv) number of mature individuals			

Category and criteria (or Data Deficient): Critically Endangered B1ab(iii).

Eligibility against the criteria: *E. vesper* is restricted to a short section (~20km) of the Cudgegong River and its tributaries. It has been recorded in the upper section of the swamp but has not been downstream (Shane Ahyong, 2021 unpub). The EOO of 20 km^2 (actual EOO is estimated at 6.91 km^2) meets the threshold for Critically Endangered listing under B1. The AOO of 20 km^2 satisfies Endangered under criterion B2.

E. vesper is only known from five hydrologically connected sites that are considered as a single location because a single threatening event has the potential to rapidly affect all individuals of the species present (IUCN 2019). Accordingly, the species satisfies subcriterion (a) for Critically Endangered listing.

This isolation increases the risk of extirpation of an individual subpopulation through environmental and demographic stochasticity (De Castro & Bolker 2005). Therefore, established, emergent, and future threats could all potentially rapidly eliminate all specimens in the taxon. In particular, species of *Euastacus* have been identified as having limited tolerance to abiotic changes (Lowe et al. 2010, Bone et al. 2014, Bone et al. 2017) and are susceptible to ongoing declines in habitat through climate change (Hossain et al. 2018). In particular, it is inferred that there will be a decline in area, extent and/or quality of habitat due to impacts of climate change (principally more frequent and intense extreme weather events, increasing temperature, and reduced moisture availability) that may lead to ecosystem collapse (cf. Bergstrom et al. 2021), satisfying subcriterion (b)(iii).

The data presented above demonstrate that *E. vesper* meets the relevant elements of Criterion B to make it eligible for listing as Critically Endangered (B1ab(iii)) under this criterion.

C. Small population size and decline

(population size, distribution and evidence of decline)

Criterion 3. Population size and decline		Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals		< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b)	Extreme fluctuations in the number of mature individuals			

Category and criteria (or Data Deficient): Insufficient data.

Eligibility against the criteria: There are no estimates of numbers of mature individuals, population-size, or any population-decline data that will allow assessment of *E. vesper* for eligibility for listing under Criterion C.

The species has been sampled at five known sites across a restricted range with 100% of mature individuals occur in the single known subpopulation. Thus, if less than 10,000 mature individuals of *E. vesper* existed in the population, the species would be eligible for listing as Vulnerable (C2a(ii)) under Criterion C. Without a population size estimate, however, there are insufficient data to determine the eligibility of the species for listing in any category under this criterion.

D. Very small or restricted population

(population size)

D. Very small or restricted population	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	D1. < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

Category and criteria (or Data Deficient): Insufficient data.

Eligibility against the criteria: The number of mature individuals of *E. vesper* is presently unknown, making assessment against Criterion D1 not possible.

The restricted AOO of 20 km^2, only a single location, and plausible future threats that could drive the species to Critically Endangered or Extinct in a very short time satisfy the elements of Criterion D2 to make it eligible for listing as D2 Vulnerable.

E. Quantitative analysis

(statistical probability of extinction)

Criterion 5. Quantitative Analysis	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

		Category and criteria (or Data Deficient): Insufficient data. **Eligibility against the criteria:** Presently, quantitative analysis has not been undertaken for *E. vesper*.

k) Additional information

i) Fisheries Scientific Committee Management Recommendations for *Euastacus vesper*

Recommended management and research actions that will benefit the conservation of the species:

- Advisory material to help recreational fisheries distinguish common yabby from *Euastacus vesper*.
- Establishment of population monitoring program to identify new populations of the species (to determine comtemporry geographic range) as well as track the trajectory of known popualtions..
- Address critical knowledge gaps on the biology, ecology and life history of E. vesper and the impacts of identified threats (e.g. thermal tolerances, competition with E. armatus)
- Control/eradication of *E. armatus* population from *E. vesper* habitats.
- Restrictions on/discontinuation of fish stocking upstream of Kandos Weir.
- Protection of the habitat from damage (livestock access, weed spraying, land clearing, road crossing impacts etc).
- Ex situ conservation/translocation to establish a separate population in an area of viable habitat.
- Maintain strict quarantine regulations/restrictions of import of crayfishes into Australia.

ii) Priorities Action Statement

The NSW Department of Primary Industries Priorities Action Statement (PAS) is a statutory, non-regulatory document addressing each threatened species, population, ecological community and key threatening process (KTP) listed on the schedules of the *Fisheries Management Act 1994*. The PAS provides an agreed list of strategies and actions that will assist to down-grade or de-list species, populations and ecological communities from the threatened species schedules of the *Fisheries Management Act 1994*, as well as actions that will assist to abate or eliminate the impacts of KTPs.

The draft Priorities Action Statement for the *Euastacus vesper* is being drafted as part of the NSW listing process and will be available on the NSW DPI Website when finalised at www.dpi.nsw.gov.au/fishing/threatened-species/priorities-action-statement

l) Statement on the standard of scientific evidence and adequacy of survey:

This assessment has been prepared by the Fisheries Scientific Committee in good faith using the highest possible standard of scientific evidence and adequacy of survey.

As prescribed under Section 4 of the Intergovernmental MOU on the CAM, in preparing this documentation the Committee gave consideration to:

(i) the nature of the data, including adequacy of survey (occurrences) and monitoring (to detect change), including factors such as sampling design, effort applied, number of variables considered, proportion of a species' range covered, time period covered etc.;

(ii) the number of data sets relevant to the conclusion;

(iii) the range of uncertainty in the data and degree of consistency between different data sets;

(iv) the source of the data and its credibility; and

(v) the relevance of the data to the particular assessment criterion.

m) References

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