

***Phebalium speciosum* Telford (Rutaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: not listed

Current NSW TSC Act Status: Critically Endangered

Proposed change for alignment: List on EPBC Act as Critically Endangered

Conservation Advice: *Phebalium speciosum*

Summary of Conservation Assessment

Phebalium speciosum is found to be eligible for listing as Critically Endangered under Criterion B1(a),(b)(iii) and B2 (a),(b)(iii). The main reasons this species is eligible for listing are: i) it has a very highly restricted geographic range, with an area of occupancy (AOO) of only 8 km², based on 2 × 2 km grid cells, the scale recommended by the IUCN (2017). The extent of occurrence (EOO) is also estimated to be 8 km²; ii) a continuing decline is inferred in the quality of habitat, due to invasive weeds, road clearing, pesticide drift, and trampling, iii) the species is only known from one location (*sensu* IUCN 2017).

Description and Taxonomy

Phebalium speciosum was described by Telford (2003) as a “shrub to 3 m tall. Branchlets ferruginous lepidote. Leaves with petioles 3–4.7 mm long, channelled above, silver and ferruginous lepidote; lamina lanceolate or narrowly elliptical, 25–84 mm long, 7.5–22 mm wide, obtuse; margin undulate, slightly recurved; adaxial surface dark green, silvery stellate, becoming minutely papillose by erosion of hair branches, the midvein deeply impressed; abaxial surface silvery and ferruginous lepidote. Inflorescences terminal, sessile umbels of 4–8 flowers; pedicels 7.5–10 mm long, slightly thickening distally, ferruginous lepidote. Calyx cup-shaped with 6–8 lobes, silvery and ferruginous lepidote outside, silvery lepidote inside; cup c. 2 mm long, 4.2–4.8 mm diam.; lobes erect, triangular, 2.2–3 mm long, acute. Corolla of 6–8 petals, of which 4 adjacent spreading, the other 2–4 more or less erect, clawed; claw 1.5–2 mm long, glabrous, white to pale pink lamina obovate or elliptical, 8.4–10.2 mm long, 3.2–5 mm wide, shortly acuminate, margin minutely crenulate; adaxial surface glabrous, deep pink paling with age; abaxial surface silvery and ferruginous lepidote with a glabrous marginal band. Stamens 12–14, inclined over the 4 spreading petals; filaments filiform, 6.5–11 mm long, glabrous, pink; anthers oblong, 1.7–2.5 mm long, yellow. Ovary subglobose, 2–3 mm diam., of 6 or 7 free carpels; carpels 2–2.3 mm long, ferruginous lepidote; style 5–5.5 mm long, glabrous, recurved above stamens; stigma capitate, minutely papillose. Cocci ellipsoidal, 4–4.2 mm long, 2.4–3.2 mm wide, ferruginous lepidote. Seeds ellipsoidal, 2.6–3 mm long, 1.2–1.6 mm wide, longitudinally striate, black.”

Distribution and Abundance

The NSW Scientific Committee (2016) state that “The geographic distribution of *Phebalium speciosum* is very highly restricted. The area of occupancy (AOO) and extent of occurrence were both estimated to be 8 km². The AOO is based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2014).” The committee also found that “There are currently two known populations of *Phebalium speciosum*. The population at Battery Hill is within Yabbra State Forest. Much of the flat country of the State Forest is under pine plantation, however, the outcrop of Battery Hill is of natural vegetation. Based on an informal count of individuals growing on the slopes and summit of Battery Hill, there are in excess of 1,000 plants in this population. Approximately 10% of these (or less) were juveniles or seedlings at the time of the census, and the majority of these were located in the disturbed area near the road at the base of the mountain (A. Goodwin *in litt.* April 2015). No comprehensive count of the population at Cullawajune Mountain has been completed, however Telford (2013) recorded approximately 250 plants in an undisturbed rocky gully on the mountain. Further surveys are required to determine the extent of the population over the rest of the mountain.

The majority of *P. speciosum* habitat on Cullawajune Mountain falls within Yabbra National Park, with pine plantations in Yabbra State Forest bordering the north, northwest and eastern boundaries of the National Park.”

Current estimates are approximately 1150 mature individuals in total across the two sites of *Phebalium speciosum*.

Ecology

The NSW Scientific Committee (2016) state that “*Phebalium speciosum* is endemic to New South Wales (NSW) and is currently known to occur at Battery Hill and Cullawajune Mountain, approximately 80 km west northwest of Lismore, in northeastern NSW. These two mountains are acid volcanic plugs and are part of the band of volcanic outcrops of the McPherson Range and adjacent areas between Boonah in Queensland, and Woodenbong and Urbenville in NSW (Telford 2013). *Phebalium speciosum* grows at the base of the acid volcanic outcrops, on the steeper midslopes on skeletal clay-loam soils, and also on top of the escarpment among rocks, at 350–450 m altitude (A. Goodwin in litt. April 2015). *Phebalium speciosum* occurs in open forest or heath along with *Eucalyptus microcorys*, *Corymbia intermedia*, *Allocasuarina littoralis*, *Bossiaea rupicola* and *Leptospermum polygalifolium* (Telford, 2003).”

Little is known of the life history of the species. The fire response of the species is unknown. It is likely the species forms a persistent soil seed bank, but this remains to be confirmed.

Threats

The NSW Scientific Committee (2016) state that “A number of threats to *Phebalium speciosum* and its habitat have been identified (A. Goodwin in litt. April 2015). The main threat is the invasion of the habitat by the weeds *Lantana camara* (Lantana) and *Ligustrum sinense* (Privet), that compete with juvenile *P. speciosum* for light and nutrients. Both weed species are also less flammable than native shrubs and may potentially alter the fire regime of the habitat by limiting the spread of fire in low-moderate fire weather conditions. Other weed species present include *Pinus* sp. (Pine), *Solanum mauritianum* (Wild Tobacco), *Ageratina adenophora* (Crofton), *Sporobolus fertilis* (Giant Parramatta Grass), *Passiflora subpeltata* (White Passionfruit), *Passiflora edulis* (Passionfruit), *Ambrosia* sp. (Ragweed), *Bidens pilosa* (Farmers Friend), *Paspalum mandiocanum* (Broad-leaved Paspalum) and *Cinnamomum camphora* (Camphor Laurel). The proximity of the exotic pine plantations to both populations of *P. speciosum* poses a number of threats. A pine plantation perimeter road cuts through part of one population of *P. speciosum* and may result in disturbance from road maintenance operations. Other threats associated with the pine plantations include changes in soil pH, herbicide spray drift and pine wildings encroaching into the population. The Battery Hill population is close to cliffs that are frequented by rock climbers. This has led to walking tracks through the middle of the site and some trampling of *P. speciosum* plants (A. Goodwin in litt. April 2015; Telford 2013).”

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Phebalium speciosum* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A Population size reduction.

Assessment Outcome: Data Deficient.

Justification:

Insufficient data to assess.

Criterion B Geographic range

Assessment Outcome: Critically Endangered B1(a),(b)(iii) and B2 (a),(b)(iii).

Justification:

Phebalium speciosum has an estimated area of occupancy of 8 km², based on two, 2 × 2 km grid cells, the scale recommended by the IUCN (2017). The extent of occurrence (EOO) is also estimated to be 8 km². Both of these estimates meet the thresholds for the Critically Endangered category. At least two of three additional conditions must be met. These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or there is only 1 (CE); ≤5 (EN); or ≤10 (VU) locations.

Assessment Outcome: subcriterion met at critically endangered threshold.

Justification: Currently there are two sites, separated by approximately 1.5 km of intervening pine plantation. It is unclear whether these sites are acting as a single unit, with genetic exchange, or as two populations, with limited exchange. In terms of conservation threats, these two sites constitute a single location, as the same threatening processes apply to both. The main threat facing *Phebalium speciosum* is weed invasion, and this applies to both sites. Many of the other threats facing *Phebalium speciosum* are associated with the pine plantation, which borders both populations. Any of a number of random events could lead to the loss of a large number of individuals. These include pesticide drift, expansion of maintenance roads, and changes in soil pH. These are believed to be equally likely on either perimeter of the plantation (i.e at both known sites for *P. speciosum*).

- b) A projected or continuing decline is observed, estimated or inferred in the area, extent and/or quality of habitat, (b) (iii).

Assessment Outcome: subcriterion met.

Justification: A continuing decline is estimated in the quality of habitat due to weed invasion, trampling due to recreational use, potential clearing due proximity to a road, and potential herbicide drift and soil pH change due to the nearby pine planation.

- c) Extreme fluctuations.

Assessment Outcome: subcriterion data deficient.

Justification: *Phebalium speciosum* was described in 2013. There is currently no documented evidence of a fluctuating population. Population estimates have varied widely over time, especially for the Battery Hill site (estimated to be 200 mature individuals in 2012, but over 900 in 2015.) Many *Phebalium* species are obligate seeders after fire: all adult individuals die, and are replaced by a new cohort of juveniles. If this is the case in *Phebalium speciosum*, there is the potential for large fluctuations in the number of mature adults. However, the fire response of this species is currently unknown.

Criterion C Small population size and decline.

Assessment Outcome: Endangered C2(a)(ii) to Vulnerable C2 (a)(i) to least concern.

Justification:

There are estimated to be approximately 1150 mature individuals across the two *Phebalium speciosum* sites. In terms of the population thresholds established for this criterion, *Phebalium speciosum* meets the threshold for listing as endangered (≤2500 mature individuals). However, in order to be listed under Criterion C, a species must also meet one of two subcriteria. These are:

C1. An observed, estimated or projected continuing decline of at least 10, 20 or 25% in 10, 5 or 3 years or 3, 2 or 1 generations, respectively (up to a max. of 100 years in future).

Assessment Outcome: Data Deficient.

Justification: *Phebalium speciosum* is Data Deficient for subcriterion C1, as there is no record of its population over time.

C2. An observed, estimated, projected or inferred continuing decline.

Assessment Outcome: subcriterion met.

Justification: A continuing decline is inferred due to weed invasion, trampling due to recreational use, potential clearing due proximity to a road, and potential herbicide drift and soil pH change due to the nearby pine plantation.

In addition, at least 1 of the following 3 conditions must be met:

- a (i). Number of mature individuals in each population ≤ 50 (CE); ≤ 250 (EN) or ≤ 1000 (VU).

Assessment Outcome: subcriterion met at Vulnerable threshold or not met.

Justification: If it is assumed both sites are part of the one population, then this subcriterion is not met. If they are considered to be separate populations then all populations ≤ 1000 mature individuals. The Battery Hill site is estimated to consist of 900 mature individuals (78% of total individuals) and the Mount Cullawajune site consists of approximately 250 individuals (22% of total individuals). Given the close proximity of the sites, it is likely that there is some movement of pollinators between the sites and they may be functioning as one population. There is not likely to be seed dispersal between sites.

- a (ii). % of mature individuals in one population = 90-100% (CE); 95-100% (EN); or 100% (VU);

Assessment Outcome: subcriterion met at Critically Endangered threshold or not met.

Justification: If it is assumed both sites are part of the one population, then 100% of plants are in one population. If both sites are considered to be separate populations then The Battery Hill site is estimated to consist of 900 mature individuals (78% of total individuals) and the Mount Cullawajune site consists of approximately 250 individuals (22% of total individuals). Given the close proximity of the sites, it is likely that there is some movement of pollinators between the sites and they may be functioning as one population. There is not likely to be seed dispersal between sites.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: subcriterion data deficient.

Justification: *Phebalium speciosum* was described in 2013. There is currently no documented evidence of a fluctuating population. Population estimates have varied widely over time, especially for the Battery Hill site (estimated to be 200 mature individuals in 2012, but over 900 in 2015.) Many *Phebalium* species are obligate seeders after fire: all adult individuals die, and are replaced by a new cohort of juveniles. If this is the case in *Phebalium speciosum*, there is the potential for large fluctuations in the number of mature adults. However, the fire response of this species is currently unknown.

Criterion D Very small or restricted population.

Assessment Outcome: Vulnerable D2

Justification:

The threshold for listing as Vulnerable is 1000 individuals (D), or an area of occupancy (AOO) of $< 20 \text{ km}^2$, with number of locations < 5 , and a credible threat that could drive the population down quickly (D2). With an AOO of 8 km^2 and only 1 location, *Phebalium speciosum* could rapidly become extinct due to suppression by weeds and would meet the requirement for listing under D2.

Criterion E Quantitative Analysis.

Assessment Outcome: Data Deficient.

Justification:

No quantitative analysis has been carried out to assess the probability of extinction in this taxon.

Conservation and Management Actions

There is currently no recovery plan for this species, while a NSW Saving Our Species site managed program is being developed. The following is derived from the threat information and the development of an SOS site management plan.

Habitat loss, disturbance and modification

- Trampling by recreational users is a threat at one site (Battery Hill). Establishing fenced walking tracks and/or installing informational signage would be effective ways to combat this threat.
- Threats related to the pine plantation affect both sites. Work with plantation managers to:
 1. Ensure that pine plantations are not expanded into *Phebalium speciosum* habitat.
 2. Ensure that road maintenance is performed without destroying existing individuals or potential habitat.
 3. Develop pesticide regimes that will minimize drift towards the *Phebalium speciosum* sites and changes to soil pH.
 4. Develop fertilization regimes that will minimize leaching and changes to soil pH.
 5. Limit the spread of pine wildings.
- The two existing sites are unreserved. Extending a nearby national park (Toonumbar National Park) would incorporate them into the reserve system.

Invasive species

- As a first priority, control and remove *Lantana camara* (Lantana) and *Ligustrum sinense* (Privet), two noxious weeds that form dense thickets and compete with juvenile *Phebalium speciosum*.
- Secondly target other weed species present in the area, including *Solanum mauritianum* (Wild Tobacco), *Ageratina adenophora* (Crofton), *Sporobolus fertilis* (Giant Parramatta Grass), *Passiflora subpeltata* (White Passionfruit), *Passiflora edulis* (Passionfruit), *Ambrosia* sp. (Ragweed), *Bidens pilosa* (Farmers Friend), *Paspalum mandiocanum* (Broad-leaved Paspalum) and *Cinnamomum camphora* (Camphor Laurel).
- Limit the spread of pine wildings.
- Test for presence of the pathogen *Phytophthora cinnamomi* at the two known sites along with its impact on *Phebalium speciosum*.

Ex situ conservation

- Develop a targeted seed collection program for *ex situ* seed banking.
- Establish living collections in botanical gardens.
- *Phebalium speciosum* is an attractive plant with showy flowers and could also be suitable for development as a horticultural species by commercial nurseries.

Stakeholder Management

- Work closely with managers of the pine plantation, as threats associated with this plantation currently represent a uniform threat to *Phebalium speciosum*.
- Use signage and community engagement to inform rock climbers visiting the Battery Hill site about *Phebalium speciosum*, and how they can help to protect this species.

Survey and Monitoring priorities

- Currently, there is no information about population trends in *Phebalium speciosum* through time. Monitoring through regular surveys is urgently needed to establish mature plant population abundance, population size structure and whether the population is growing or declining, and whether there are fluctuations in population numbers, in order to guide appropriate action.
- Further surveys should be carried out to determine whether there are other populations of *Phebalium speciosum* in other patches of suitable habitat in the area.

Information and Research priorities

- A key question in determining the conservation status of *Phebalium speciosum* is whether there is genetic exchange between the two sites. Genetic work to determine whether these sites form one or two populations should be a priority. Research to determine what pollinates this species, the foraging range of the pollinators, and the conservation status of these pollinators could also be key information in protecting it in the future.
- Understanding the fire response of *Phebalium speciosum* with respect to its life history strategy should be a high priority. Several other members of the genus are obligate seeders (e.g., Bradstock et al., 1997; Clarke et al., 2002), meaning that adult plants are killed by fire, and that fire cues are normally required for seed stored in the soil to germinate. This life history strategy can be associated with fluctuations in population numbers, especially if threatening factors limit the success of new recruits following fire. Understanding the potential effects of fire would help guide conservation efforts.

References

- Bradstock, R.A., Tozer, M.G., Keith, D.A., 1997. Effects of high frequency fire on floristic composition and abundance in a fire-prone heathland near Sydney. *Aust. J. Bot.* 45, 641–655. doi:10.1071/BT96083
- Clarke, P.J., Knox, K.J.E., 2002. Post-fire response of shrubs in the tablelands of eastern Australia: do existing models explain habitat differences?, *Aust. J. Bot.* 50, 53–62. doi:10.1071/BT01055.
- IUCN Standards and Petitions Subcommittee, 2017. Guidelines for Using the IUCN Red List Categories and Criteria, Version 13.
- NSW Scientific Committee, 2016. Final Determination to list the shrub *Phebalium speciosum* I. Telford as a Critically Endangered Species [WWW Document]. URL <http://www.environment.nsw.gov.au/resources/threatenedspecies/determinations/FDPheb specCR.pdf> (accessed 13.1.17).
- Telford, I.R.H., 2003. *Phebalium speciosum* (Rutaceae: Boronieae), an endangered, narrowly endemic new species of north-eastern New South Wales, Australia. *Telopea* 15, 51–55. doi:dx.doi.org/10.7751/telopea2013007

NSW SCIENTIFIC COMMITTEE

Final Determination

The Scientific Committee, established by the *Threatened Species Conservation Act 1995* (the Act), has made a Final Determination to list the shrub *Phebalium speciosum* I.Telford as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1A of the Act. Listing of Critically Endangered species is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Phebalium speciosum* I.Telford (family Rutaceae) is described in Telford (2013) as a “shrub to 3 m tall. Branchlets ferruginous lepidote. Leaves with petioles 3–4.7 mm long, channelled above, silver and ferruginous lepidote; lamina lanceolate or narrowly elliptical, 25–84 mm long, 7.5–22 mm wide, obtuse; margin undulate, slightly recurved; adaxial surface dark green, silvery stellate, becoming minutely papillose by erosion of hair branches, the midvein deeply impressed; adaxial surface silvery and ferruginous lepidote. Inflorescences terminal, sessile umbels of 4–8 flowers; pedicels 7.5–10 mm long; slightly thickening distally, ferruginous lepidote. Calyx cup-shaped with 6–8 lobes, silvery and ferruginous lepidote outside, silvery lepidote inside; cup c.2 mm long, 4.2–4.8 mm diam.; lobes erect, triangular, 2.2–3 mm long, acute. Corolla 6–8 petals, of which 4 adjacent spreading, the other 2–4 more or less erect, clawed; claw 1.5–2 mm long, glabrous, white to pale pink lamina obovate or elliptical, 8.4–10.2 mm long, 3.2–5 mm wide, shortly acuminate, margin minutely crenulate; adaxial surface glabrous, deep pink paling with age; adaxial surface silvery and ferruginous lepidote with a glabrous marginal band. Stamens 12–14, inclined over the 4 spreading petals; filaments filiform, 6.5–11 mm long, glabrous, pink; anthers oblong, 1.7–2.5 mm long, yellow. Ovary subglobose, 2–3 mm diam., of 6 or 7 free carpels; carpels 2–2.3 mm long, ferruginous lepidote; style 5–5.5 mm long, glabrous, recurved above stamens; stigma capitate, minutely papillose. Cocci ellipsoidal, 4–4.2 mm long, 2.4–3.2 mm wide, ferruginous lepidote. Seeds ellipsoidal, 2.6–3 mm long, 1.2–1.6 mm wide, longitudinally striate, black.”
2. *Phebalium speciosum* is endemic to New South Wales (NSW) and is currently known to occur at Battery Hill and Cullawajune Mountain, approximately 80 km west northwest of Lismore, in northeastern NSW. These two mountains are acid volcanic plugs and are part of the band of volcanic outcrops of the McPherson Range and adjacent areas between Boonah in Queensland and Woodenbong and Urbenville in NSW (Telford 2013). *Phebalium speciosum* grows at the base of the acid volcanic outcrops, on the steeper midslopes on skeletal clay-loam soils, and also on top of the escarpment among rocks at 350–450 m altitude (A. Goodwin *in litt.* April 2015). *Phebalium speciosum* occurs in open forest or heath along with *Eucalyptus microcorys*, *Corymbia intermedia*, *Allocasuarina littoralis*, *Bossiaea rupicola* and *Leptospermum polygalifolium* (Telford 2013).
3. There are currently two known populations of *Phebalium speciosum*. The population at Battery Hill is within Yabbra State Forest. Much of the flat country of the State Forest is under pine plantation but the outcrop of Battery Hill is native vegetation. Based on an informal count of individuals growing on the slopes and summit of Battery Hill, there are at least 1,000 plants in this population. Approximately 10% of these (or less) were juveniles or seedlings at the time of the census and the majority of these were located in the disturbed area near the road at the base of the mountain (A. Goodwin *in litt.* April 2015). No comprehensive count of the population at Cullawajune Mountain has been completed, however Telford (2013) recorded approximately 250 plants in an undisturbed rocky gully on the mountain. Further surveys are required to determine the extent of the population over the rest of the mountain. The majority of *P. speciosum* habitat on Cullawajune Mountain falls within Yabbra National Park, with pine plantations in Yabbra State Forest bordering the north, northwest and eastern boundaries of the National Park.
4. The geographic distribution of *Phebalium speciosum* is very highly restricted. The extent of occurrence and area of occupancy (AOO) were both estimated to be 8 km². The AOO is based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2014).

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5. A number of threats to *Phebalium speciosum* and its habitat have been identified (A. Goodwin *in litt.* April 2015). The main threat is the invasion of the habitat by the weeds *Lantana camara* (Lantana) and *Ligustrum sinense* (Small-leaved Privet), that compete with juvenile *P. speciosum* for light and nutrients. Both weed species are also less flammable than native shrubs and may potentially alter the fire regime of the habitat by limiting the spread of fire in low-moderate fire weather conditions. Other weed species present include *Pinus* sp. (Pine), *Solanum mauritianum* (Wild Tobacco), *Ageratina adenophora* (Crofton), *Sporobolus fertilis* (Giant Parramatta Grass), *Passiflora subpeltata* (White Passionfruit), *Passiflora edulis* (Passionfruit), *Ambrosia* sp. (Ragweed), *Bidens pilosa* (Farmers Friend), *Paspalum mandiocanum* (Broad-leaved Paspalum) and *Cinnamomum camphora* (Camphor Laurel). The proximity of the exotic pine plantations to both populations of *P. speciosum* poses a number of threats. A pine plantation perimeter road cuts through part of one population of *P. speciosum* and may result in disturbance from road maintenance operations. Other threats associated with the pine plantations include changes in soil pH, herbicide spray drift and pine wildings encroaching into the population. The Battery Hill population is close to cliffs that are frequented by rock climbers. This has led to walking tracks through the middle of the site and some trampling of *P. speciosum* plants (A. Goodwin *in litt.* April 2015; Telford 2013). ‘Invasion, establishment and spread of Lantana (*Lantana camara* L. *sens. lat.*)’; and the ‘Invasion of native plant communities by exotic perennial grasses’ are listed as Key Threatening Processes under the Act.
6. *Phebalium speciosum* I.Telford is eligible to be listed as a Critically Endangered species as, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future as determined in accordance with the following criteria as prescribed by the *Threatened Species Conservation Regulation 2010*:

Clause 7 Restricted geographic distribution and other conditions

The geographic distribution of the species is estimated or inferred to be:

- (a) very highly restricted,
and:
(d) a projected or continuing decline is observed, estimated or inferred in the key indicator:
(b) the geographic distribution, habitat quality or diversity, or genetic diversity of the species.

Dr Mark Eldridge
Chairperson
NSW Scientific Committee

Exhibition period: 16/12/16 – 10/02/17

Proposed Gazettal date: 16/12/16

References:

Telford IRH (2013) *Phebalium speciosum* (Rutaceae: Boronieae), an endangered, narrowly endemic new species of north-eastern New South Wales, Australia. *Telopea* **15**, 51–55.

IUCN Standards and Petitions Subcommittee (2014) Guidelines for Using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee.

<http://www.iucnredlist.org/documents/RedListGuidelines.pdf>