Brown Bear (*Ursus arctos*)

Brown Bear (*Ursus arctos*) Isolated Subpopulations

Because the conglomerate Brown Bear population is large and spread over portions of three continents, globally they are Least Concern. However, there are many small, isolated populations that are threatened. Some, such as the Brown Bears of the Gobi Desert in Mongolia, are genetically isolated and ecologically unique so their status is of great concern. Other populations are demographically separated from the large, continental populations (spanning across Alaska, Canada, and Russia) by a very short distance and, although they can usually be distinguished by their genotypes, are genetically and ecologically similar to adjacent populations (Proctor *et al*. 2012). Here we apply IUCN Red List Criteria for isolated populations of Brown Bears (see Table 1) following the guidance of Gärdenfors *et al*. (2001) and IUCN (2012). In some cases these assessments have been adjusted by one category, as suggested by Gärdenfors *et al*. (2001) and IUCN (2012):

> "If the taxon is endemic to the region or the regional population is isolated, the Red List Category defined by the criteria should be adopted unaltered. If, on the other hand, conspecific populations outside the region are judged to affect the regional extinction risk, the regional Red List Category should be changed to a more appropriate level that reflects the extinction risk as defined by criterion E (IUCN 2001, 2012). In most cases, this will mean downlisting the category obtained in step two, because populations within the region may experience a rescue effect from populations outside the region".

Following this directive, we made these adjustments based on 3 criteria:

1. Fracture width. The distance, measured in average female dispersal distance, from a population boundary to a large, healthy population. We use female dispersal distance because our definition of an isolated population is <1 female immigrants per generation. This logic was informed by Proctor *et al*. (2012) which detailed sex-specific fragmentation of populations across much of western North America.
2. Fracture severity. The degree that that the fracture is potentially permeable to dispersing female bears with improved management actions.
3. Actual applied management actions. The level of management actions that are being applied to improve the probability of female movement into the isolated population. These actions are usually improving conditions within the fracture but can also be based on successful (moved bears produce offspring) augmentation.

These criteria were not quantified for all subpopulations for this analysis, although, with a major effort they could be, at least to some degree. In this assessment, actual movement data based on radio telemetry or genetic sampling were used in several areas but in others they were qualified subjectively. Any subpopulation that was downlisted is marked in the text below with •, (example, Red List Category: VU•).

Several populations are assessed under criterion D (isolated and small number of mature individuals). For purposes here, mature individuals are assumed to represent 55% of the total population, and an isolated population is defined as one that has less than one female immigrant per generation (10 years). Such information is unavailable for many populations but, based on knowledge of female brown bear dispersal rates and distances (Swenson *et al*. 1998, McLellan and Hovey 2001, Proctor *et al*. 2004, Støen *et al*. 2006, Proctor *et al*. 2012), it is possible to estimate the degree of isolation for populations where data on bear movements are absent.

Table 1. Isolated Brown Bear populations with their IUCN Red List Category and Criteria

Population	Countries	Degree of isolation	Population size (mature adults)	Population area (km²)	Population trend	Red List Category	Red List Criteria
NORTH AMERICA							
Kodiak Islands	USA (Alaska)	Complete 37 km of ocean	3,500 (2,400)	9,311	increasing stable	LC	
Admiralty Island	USA (Alaska)	<1 F/gen male connectivity to mainland	1,500 (825)	3,868	stable	LC	
Chichagof, Baranof Islands	USA (Alaska)	<1 F/gen male connectivity to mainland	2,600 (1,430)	9,471	stable	LC	
Stein / Nahatlatch	Canada (British Columbia)	<1 F/gen recent male exchange	15-25 (8-14)	7,710	slight decline	CR	D
North Cascades	Canada, USA	Complete	<10 (6)	25,000	unknown	CR	D
Fountain Valley and Hat Creek	Canada (British Columbia)	<1 F/gen	<10 (6)	1,400	unknown	CR	D
Greater Yellowstone Ecosystem	USA	Complete	610-718 (335-395)	50,280	slightly increasing	VU	D1
South Selkirks	Canada, USA	<1 F/gen	93 (52)	6,800	slightly increasing	VU•[1]	D1
Yahk-Yaak	Canada, USA	<1 F/gen	48 (26)	11,520	stable	EN•[1]	D

Population	Countries	Degree of isolation	Population size (mature adults)	Population area (km^2)	Population trend	Red List Category	Red List Criteria
Cabinet Mts	USA	Complete	24 (13)	3,944	stable	EN•[1]	D
EUROPE							
Alpine	Italy, Switzerland, Austria, Slovenia	<1 F/gen minimal male connectivity to Dinaric-Pindos	45-50 (25-28)	12,200	stable to slightly increasing	CR	D
Central Apennine	Italy	complete	37-52 (20-29)	6,400	stable	CR	D
Eastern Balkans	Bulgaria, Greece, Serbia	complete	610 (336)	39,000	stable	VU	D1
Baltic	Estonia, Latvia	connected to larger Russian Federation population[3]	710 (390)	50,400	increasing	LC	
Cantabrian	Spain	complete	195-210 (107-116)	7,700	stable to increasing	EN	D
Carpathian	Romania, Serbia, Poland, Slovakia, Ukraine	<1 F/gen possibly minimal male connectivity	8,100 (4,455)	122,600	stable	LC	
Dinaric-Pindos	Slovenia, Croatia, Bosnia & Herzagovina, Serbia, FYRO – Macedonia, Montenegro, Albania, Kosovo[2,] Greece	<1 F/gen minimal male connectivity to Alpine	3,000 (1,650)	115,300	stable to declining	VU	C2a(i)
Finnish-Karilian	Finland, Norway	connected to Russian Federation and Baltic populations[3]	2,000	381,500	stable	LC	
Pyrenean	France, Spain, Andorra	complete	25 (14)	17,200	stable due to augmentation from Dinaric-Pindos	CR	D

Population	Countries	Degree of isolation	Population size (mature adults)	Population area (km^2)	Population trend	Red List Category	Red List Criteria
Scandinavian	Sweden, Norway	<1 F/gen, male connectivity to Finnish-Karilian	3,400 (1,870)	466,700	increasing	LC	
MID EAST ASIA							
Eastern Anatolia-Lesser Caucasus	Turkey	<1 F/gen, male connectivity to lesser Caucasus	2,000-2,400 (1100-1320)	161,880	stable	LC	
Greater Causasus Mts	Georgia, Azerbiajan	complete	>2,000 (>1,000)	82,700	unknown	NT	D1
Kure Mountain-Western Black Sea	Turkey	<1 F/gen, male connectivity possible with Western Anatolia	750-800 (413-440)	18,000	unknown	VU	D1
Western Anatolia	Turkey	<1 F/gen	300-400 (165-220)	23,200	unknown	EN	D
Eastern Toros Mountains	Turkey	complete	(~<250)	11,800	unknown	EN	D
Western Toros Mountains	Turkey	complete	(~<250)	6,000	unknown	EN	D
Aegean	Turkey	complete	100-150 (<55-82)	3,000	unknown	EN	D
Datca	Turkey	complete	<50 (<28)	<1,500	unknown	CR	D
South Armenian-Iran	Armenian Iran	complete	(<250)	25,600	unknown	EN	D
Aragat Mountain	Armenia	complete	(<50)	1,050	unknown	CR	D
Mingacevir Reservoir	Georgia, Azerbiajan	complete	~20 (~<11)	<3,900	unknown	CR	D
Zagros Mountains	Iran, Iraq	complete	130-150 (72-83)	34,000	unknown	EN	D
Elburz Mountains	Azerbaijan, Iran, Turkmenistan	complete	1,300 (715)	25,000	unknown	VU	D1
CENTRAL ASIA							

Population	Countries	Degree of isolation	Population size (mature adults)	Population area (km^2)	Population trend	Red List Category	Red List Criteria
Western China (mostly Qinghai-Tibetan Plateau)	China	complete	6,300 (3,465)	2,400,000	unknown	LC	
Himalaya Mountains	Nepal, India, Pakistan	<1 F/gen, male connectivity with China (Tibet) possible	130-220 (72-121)	35,000	unknown	EN	D
Hundu Kush Mountains	Pakistan	complete	15-30 (8-17)	4,300	unknown	CR	D
Karakorum, Pamirs and Hissaro-Alai Mountains	Pakistan, Afganistan, China, Tajikistan	<1 F/gen , male connectivity to China (Tibet) possible	500-1,500 (275-825)	220,000	unknown	VU	D1
Tian Shan Mountains	Kyrgyzstan, Kazakhstan, Uzbekistan, China	<1 F/gen, male connectivity possible	~>1,820 (~>1,000)	200,000	possible decline	VU	D1
Western Kyrgyzstan	Kyrgyzstan, Uzbekistan, Kazakhstan	complete	<250	~20,000	unknown	EN	D
Gobi	Mongolia	complete	20-40 (11-22)	15,000	stable	CR	D
Hokkaido	Japan	complete	2,200-6,500 (1,210-3,575)	78,000	stable	LC	
Kunashiri Island (Kuril Islands)	Russian Federation / Japan[4]	complete	130 (72)	1,500	stable	EN	D
Etorofu (Iturup) Island(Kuril Islands)	Russian Federation / Japan[4]	complete	360 (198)	6,725	stable	EN	D
Paramushir Islands (Kuril Islands)	Russian Federation	complete	~450 (~<250)	2,050	unknown	EN	D

[1] Category downlisted due to proximity of large adjacent population within female dispersal distance, potentially permeable fracture, and active conservation management.

[2] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence.

[3] Identified for jurisdictional management and ecological similarity reasons.

[4] Ownership is disputed between the Russian Federation and Japan.

NORTH AMERICA

Approximately 58,000 Brown/Grizzly Bears live in one interconnected, continental population across most of Alaska, Yukon, and British Columbia, as well as portions of the Northwest Territory, Nunavut and Alberta. Additionally, there are several populations that are naturally isolated and others that are isolated due to human settlement, other developments, and historic excessive human-caused mortality.

Kodiak Islands, Alaska: Brown Bears on Kodiak Islands are naturally isolated by at least 37 km of ocean. They were likely founded by very few bears as their genetic diversity remains extremely low (Paetkau *et al*. 1998). These are large bears that feed primarily on salmon. They have high reproductive rates (Smith and van Daele 1991, van Daele *et al*. 2012) and are found at high densities (Miller *et al*. 1997, Van Daele and Cyre 2007). In 2005 there were an estimated 3,500 bears on these islands and 2,400 were >3 years of age (Van Daele *et al*. 2013). The population is thought to have increased by 16.7% from 1995 to 2005 with a harvest of approximately 165 bears/year (Van Daele and Cyre 2007). As in many brown bear populations, bears on Kodiak Islands are ecologically flexible and have high reproductive rates across a great variety of ecological conditions (van Daele *et al*. 2012).

Red List Category: LC

ABC Islands, Southeast Alaska: Very high densities of Brown Bears (Schoen and Biere 1990, Miller *et al*. 1997) are found on Admiralty, Chichagof, and Baranof Islands of Southeast Alaska. Although these islands are as close as 4 km from the mainland, there is little (<1 immigrant per generation) female immigration to these islands (Paetkau, *et al*. 1998). Some female bears move between Baranof and Chichagof Islands but not between these and Admiralty (Paetkau *et al*. 1998), suggesting these are two separate populations. There are an estimated total of 5,000 bears in these populations (Kim Titus, pers. comm., Aug 2013). The Alaska Department of Fish and Game has set a target of 166 bears per year to be killed by hunters and for other reasons. Overall, the long-term data on skull size and harvest statistics is thought to indicate a large, stable population (Mooney 2007).

Red List Category: LC

Stein/Nahatlatch (SN) Southwestern British Columbia: A very small (15–25), and until recently, fully isolated Grizzly Bear population is found in the southern coastal mountains of British Columbia. This population has the least genetic variability of any North American Brown Bear population (0.49), other than Kodiak Island (Apps *et al*. 2009). The southern boundary is a band of poor habitat dominated with plantation forestry and the lower Fraser valley that is populated agricultural land. A portion of the North Cascades population, where there are extremely few Grizzly Bears, is found south and east of this area. The eastern boundary is the Frazer River canyon, Trans-Canada highway, and Canadian National (CN) and Canadian Pacific Railroad (CPR). The western boundary is the Harrison Lake, Lillooet River, and Lillooet Lake. This boundary is likely more permeable for bear movement than the south or eastern boundary, but there are very few if any bears to the west (see Garabaldi/Pitt). There is a larger and expanding population of Grizzly Bears to the north of the SN towards the southern extreme of the continental population. The northern fracture is a semi-settled valley of

rural homes and hobby farms, with a minor railroad (CN) and highway. Two lakes, only about 1.5 km wide, form a part of the fracture.

Bears have been monitored using DNA from hair traps and rub trees, and via radio telemetry in this area for eight years. Within the last three generations, this population has gone through a “bottleneck” and almost all individuals have the same grandmother or great grandmother (Apps *et al*. 2009). One male has recently (between 2006 and 2012) immigrated into this population, two males have emigrated, and one began moving back and forth in 2013. There is no indication of any female immigration. In the past decade, at least three females have been killed by people and three have died of natural causes, suggesting that the population has recently declined. Recruitment into this population has also been low.

The SN population has large (1,311 km²) wilderness parks in the center, and has rich, herbaceous avalanche chutes and alpine meadows with an abundance of spring bear foods (McLellan 2007); however, summer and fall energy fruits are not abundant. Some huckleberries are produced in logged areas but these areas are not extensive and conifer regrowth is limiting productivity. There are spawning salmon in some streams but these receive no use by most females. It is not certain to what degree habitat conditions, inbreeding, stochastic events or human-caused mortality are limiting this population and it is probable that all factors are having some influence. There is currently no recovery plan for this population, although one is being developed (Hamilton A.N., pers. comm).

This population has much fewer than 50 mature individuals and currently there has been no management action to enhance female immigration and thus we have not downlisted the risk of extinction of this population but left it as CR.

Red List Category: CR

Criteria: D

Garabaldi/Pitt, Southwest British Columbia: Immediately to the west of the Stein Nahatlach population is a large, mountainous area with very few Grizzly Bears, likely less than five individuals. To the south of this area is the city of Vancouver (≈2,500,000 people). The western boundary is Howe Sound of the Pacific Ocean, and Highway 99 through the towns and resorts of Squamish and Whistler. This area is not a boundary to female movement as one collared female crossed into the Garabaldi/Pitt and returned. The northern boundary is the settled farmland and communities of Pemberton and Mount Currie. At the center of this area are protected areas covering 3,020 km² of mostly unroaded wilderness. Because female immigration is possible and movement into this area has been documented, we have not identified these bears as a separate population but consider them as the southwestern extreme edge of the continental population of bears.

Cascades, Washington and British Columbia: Over the past 40 years, there have been >200 reported sightings of Grizzly Bears scattered across approximately 15,000 km² in the Cascade Mountains of southern British Columbia (Guy 2002). This area is immediately north of the North Cascades Grizzly Bear Ecosystem in Washington State, USA (Servheen 1982) where there are very few, if any Grizzly Bears (Romain-Bondi et al. 2004). With so few bears and no information on movements, boundaries must be estimated based on other criteria including habitat quality, barriers to migration and presence of bears in potential source areas. The western boundary is the Fraser and

Thompson Rivers that run in deep canyons. To the west of these rivers is the Stein/Nahatlach population that is also small and, in its current status, an unlikely source of immigrant bears. The eastern boundary is largely undefined as habitat conditions gradually deteriorate but can be confidently assumed to be the Okanagan valley that is wide (>10 km), highly developed with large towns, expansive agriculture, and large lakes. No female bears will immigrate from the east as the closest female bears are >50 km away and across this highly developed population fracture. The northern boundary is again poorly defined as habitat conditions deteriorate to the Thompson River valley that has the Trans-Canada Highway, CP and CN Rail, large lakes, agriculture, and major towns. The number of bears living in this large area is unknown but thought to be <10. A hair-trapping DNA grid in 1999 found 1 female grizzly bear. A female with one cub and 2 independent bears were seen during this hair-trapping program. In 2011, a Grizzly Bear was photographed in a camera trap established for wolverine and in 2015 a Grizzly Bear was photographed in a trail camera.

The US portion of this area in Washington State is part of the U.S. Fish and Wildlife Grizzly Bear Recovery Zone (Servheen 1982, 1997). In British Columbia, the population also has a formal recovery plan (North Cascades Grizzly Bear Recovery Team 2004) but it has not been implemented. We choose not to downlist this rank because there are no large source populations within the female dispersal distance and there are no active management activities to recover this population.

Red List Category: CR

Criteria: D

Fountain Valley and Hat Creek, British Columbia: Very little is known about grizzly bears in this small (approximately 1,400 km^2), triangular shaped area between the Fraser and Thompson Rivers and south of Pavilion. One certain sighting of a female with two yearlings in 2007 and a bear shot by a resident in 2012 confirms that bears were at least recently there and may continue to occupy the area. The numbers must be very small, likely <10. There is little chance of female immigration as the only adjacent areas with bears are the Stein/Nahatlatch and Cascades, and both of these are inhabited by small populations. The area is small and the habitat appears relatively poor. There is no plan or conservation priority for bears in this area.

Red List Category: CR

Criteria: D

Greater Yellowstone Ecosystem, USA: Currently, the most southerly Grizzly Bears in North America are found in a large (50,280 km^2; Bjornlie *et al*. 2014) area called the Greater Yellowstone Ecosystem that spans portions of Montana, Wyoming and Idaho. The population of bears has been isolated for more than a century (Mattson and Merrill 2002, Proctor *et al*. 2012) and, at 0.60, has a moderate level of genetic heterozygosity (Haroldson *et al*. 2010). These bears have been listed as Threatened under the Endangered Species Act in the US since 1975. This population has been the focus of the most long-term and one of the two most intensive research and monitoring programs of any bear population. The population increased over the past few decades with an annual growth rate of 4.1–7.6% during 1983–2001 (Schwartz *et al*. 2006), although this growth rate slowed to 0.3–2.2% during 2002–2011 (van Manen *et al*. 2015). Population expansion occurred concomitant with this growth (Bjornlie *et al*. 2014). In 2012, there

was an estimated 610–718 bears (Haroldson *et al*. 2013). There are many state and federal government management and recovery plans for this area (USFWS 1982, 1993; Moody *et al*. 2005; Montana Fish, Wildlife and Parks 2013; Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002), which are being closely followed. Over the past decade, there has been an effort to remove this "Distinct Population Segment" from the list of threatened species in the US (USFWS 2005, 2007). It is thought by managers that the population has recovered and is no longer threatened under the US Endangered Species Act.

Red List Category: VU

Criteria: D1

South Selkirks, British Columbia and USA: This international population consisted of an estimated 83 bears in 2005 (Proctor *et al*, 2012). Coupled with a well-documented 1.8% annual increase since then, there are likely >52 mature individuals extending across 6,800 km² along the Canada-US border in southeast British Columbia, northern Idaho, and eastern Washington in the US. While estimated to be increasing slightly (Wakkinen and Kasworm 2004), there is good evidence it has been totally isolated (no gene flow) for several generations as the genetic diversity (heterozygosity = 0.54) is 15% lower than adjacent populations. There are no Grizzly Bears south, and very limited numbers to the west of this population, as they were extirpated in the previous century (1850–1970). Human settlement, highways, and a large lake fragment this unit from a healthy population (>500 bears) to the north and northeast and another small isolated population exists to the east (Yaak, <50 bears, see below). The fragmentation creating this population was likely instigated by historic mortality from pioneer settlement and intensive miner activity in this region during 1850–1970, and more recently mediated by mortality associated with human settlement as a result of human–bear conflicts and to a lesser degree highway traffic mortalities (Proctor *et al*. 2012). The distance across the fractures to the north and east is only 1–5 km, well within the dispersal distance of females (McLellan and Hovey 2001, Proctor *et al*. 2004). The healthy population immediately to the northeast (>500 bears) has the potential to be a source of immigrants of both sexes (Proctor *et al*. 2012). From a near complete genetic sampling of this population there is evidence of one female migrant that has reproduced within the Selkirks within the past 25 years (M. Proctor, unpublished data, 2015). In the past one and two decades, a research and recovery management effort has occurred in the Canadian and US portions of this population respectively, reducing human-caused mortality. This effort has recently included efforts to increase inter-area exchange with neighbouring populations. Recovery Management Plans have been written for this population in the US and Canada and are currently being implemented, the latter one, partially. Because this population has <250 mature individuals and solid evidence of an extended period of isolation, it is eligible for EN status, but due to evidence of recent connectivity (Proctor *et al*. 2012), the existence of an immediately adjacent large source population within the female dispersal distance, and the existence of current active conservation management (MacHutchon and Proctor 2014), we downgraded the level of risk. This decision is supported by the real potential for continued and increased connectivity with the adjacent large population to the northeast and population recovery, both due to an extensive conservation management effort being applied in the US and Canada.

Red List Category: VU•

Criteria: D1

Yahk-Yaak, British Columbia and USA: The Yahk straddles the Canada-USA border in southeast British Columbia, northwest Montana and eastern Idaho. It encompasses 6,800 km² and has a DNA-based estimate of 48 Grizzly Bears (Proctor *et al*. 2007, Kendall *et al*. 2016). Evidence suggests this population has been declining in the past (Wakkinen and Kasworm 2004), but recent trend estimates from known-fate telemetry monitoring indicates that it is now stable (W. Kasworm, unpublished data, 2015). This population has no successful (female that actually reproduced) female immigration but experiences occasional male immigrants that mediate gene flow (Proctor *et al*. 2012). This population is bounded by the Koocanusa reservoir on the east, an area with few bears and which is a likely barrier to female dispersal (Proctor *et al*. 2012). To the south is the very small Cabinet Mountain population (see below) but separated by a major highway-settlement corridor across which there have been no detected migrants over 25 years. Female immigration from the Cabinets into the Yaak has a very low probability in the near to medium term. To the north, across a relatively narrow major highway-settlement corridor, is a large healthy population of >500 bears, which is the main source of male immigrants and potential female immigrants (Proctor *et al*. 2012). There has been an extended research and recovery management effort on the US portion of this population for 25 years, and connectivity-oriented research and management within Canada for the past decade. This effort has monitored the mechanism of fragmentation (human-caused mortality), and the potential for the re-establishment of inter-area connectivity for females. From an almost complete genetic sampling there is evidence of two female immigrants over the past 25 years, both of which were killed and we have no evidence of breeding (and thus were not successful immigrants). A Recovery Management Plan has been applied in the US for two decades and one has been recently written for the Canadian portion of this population, which is being partially implemented. Due to its small population size and female fragmentation, this population warrants CR designation. However, because there is an immediately adjacent large healthy population within the female dispersal distance, evidence of male immigration with breeding and female movements in and out of this population (no breeding yet), and active conservation management, the risk of extinction is less.

Red List Category: EN•

Criteria: D

Cabinet Mountains, USA: The Cabinet Mountain grizzly bear population has an estimated 24 Grizzly Bears (Kendall *et al*. 2016) across its 5,800 km² area and is totally isolated from adjacent neighbouring populations. It sits at the southern terminus of grizzly distribution within northwest Montana and Idaho, west of the Rocky Mountains. There are no Grizzly Bears to the west and south of the Cabinets as bears were extirpated from there during 1850–1970. To the south is the US Bitterroot Recovery Zone, which currently has no Grizzly Bears, but is being considered for re-colonization and recovery management as it contains a large area of suitable habitat (Boyce and Waller 2003). To the east, across an unoccupied zone beyond the probable female dispersal distance (McLellan and Hovey 2001, Proctor *et al*. 2004), is the large, continental population. To the north is the Yahk population, which for the near and medium-term has very minimal chances of providing female immigrants. To the northwest, is the South Selkirk population, which also has minimal potential for female

immigrants to the Cabinets; however, through genetic sampling there is evidence of one male migrant originating from the Canadian portion of the South Selkirks but with no accompanying evidence of reproduction. There have been augmentation efforts into the Cabinets during 1990–1994 and 2005–2013 (and ongoing, Kasworm *et al*. 2013). The earlier augmentation effort was successful in that the current population is dominated by descendants of one female and her offspring who reproduced successfully several times (Kasworm *et al*. 2007). This small, isolated population would be close to extinction if not for the augmentation effort. Considering the so far successful effort the USFWS is investing into researching, augmenting, and recovering this population, its extinction risk is less than the CR designation warranted by its small population size and isolation.

Red List Category: EN•

Criteria: D

EUROPE

Brown Bears in portions of northeastern Europe (Karelian and Baltic) are connected to the large North Eurasian population (≈100,000) that spreads across Russia. Other populations are smaller and isolated. All populations except two (Abruzzo and Cantabrian) are shared among two or more countries. Population level management across national borders has been generally accepted; however the implementation of this concept is far from satisfactory, especially in countries not implementing their own national plans. Agreements between countries include various degrees of coordinated-management (France with Spain, Greece with Bulgaria, Slovakia with Poland, Slovenia with Croatia, Sweden with Norway), sharing information (Sweden and Norway, Slovenia and Croatia), or most commonly, working groups have been established among scientists or managers. However, in no case is there a formal population level management plan as outlined in Linnell *et al*. (2008).

Alpine: In 2012, an estimated stable population of 45–50 bears lived in four countries in an area of approximately 12,200 km² of the Alps of Italia (Trentino) >35, Italy (Friuli) <12, Switzerland 0–1, Austria ~5, Slovenia: 5-10. The most important potential connection is with the Dinaric-Pindos population in Slovenia. A few male bears have been shown to move between these two populations in both directions. Initiatives to coordinate and harmonize bear management between Italy, Switzerland, Austria and even Germany are currently underway. However, food conditioning and/or habituated bears remain a management challenge. Low social tolerance to even minor bear-caused damages to property and perceived risks to public safety have led to the sanctioned killing of three recent immigrant bears in Germany (1) and Switzerland (2).

Red List Category: CR

Criteria: D

Central Apennine: Located mostly in Abruzzo area in Italy, a population of 37–52 bears is spread over 6,400 km² (Gervasi *et al*. 2012). This small population appears to have been stable over the last decade but has been isolated for over a century with no possibility to reestablish connectivity. Occasional losses due to poaching or other human related accidents occur and the population has not increased in size despite regular reproduction.

Red List Category: CR

Criteria: D

Eastern Balkans: Mostly in Bulgaria with about 550 bears, but also in Greece and Serbia with about 50 and eight bears, respectively, this population occupies about 39,000 km². The population is considered stable although the estimate in 2005 (720 bears) was higher due to improved assessment methods (Ministry of Environment and Waters for Bulgaria. 2008, Zlatanova *et al*. 2009). The Greek part of the Rila-Rhodope segment is near the Dinaric-Pindos population but there is no demonstrated connection between these two populations. To the north of the Stara-Planina segment there is a potential, but unproven connection to the Carpathian population. Within the Eastern Balkans the main challenge is to maintain connections among the three segments of this population. Bulgaria has developed a new bear management plan and controversies seem to have diminished. In Greece habitat fragmentation remains a conservation concern.

Red List Category: VU

Criteria: D1

Baltic: This population includes Estonia (700 bears) and Latvia (10 bears), occupying 50,400 km², and growing (Kaczensky *et al*. 2013). These bears appear to be connected with bears in the Russian Federation. Here they are separated into their own population for administrative reasons, and also to produce units of practical size with more homogeneous ecological and management conditions. Due to their connection with bears in Russia and Belarus these populations are large and occupy a large area safeguarding their favourable conservation status. However, the lack of reliable and regular information from Russia or Belarus makes it difficult to assess changes in population size or range.

Red List Category: LC

Cantabrian: Totally isolated for over a century, this population of 195–210 bears occupies 7,700 km^2 of northwestern Spain. It is subdivided into a western segment that shows an obvious increase (from three females with cubs in 1994 to 25 in 2010), whereas the eastern segment is possibly stable but there are few females with offspring (females with cubs are used as an index of population size).

Red List Category: EN

Criteria: D

Carpathian: With about 8,100 bears, this is the largest of European populations, and is shared among five countries: Romania (6,000), Poland (150), Serbia North (10), Slovakia (1,940), and Ukraine (unknown), within an area of 122,600 km². The closest population is in northern Bulgaria and southeastern Serbia, but the movement of individual bears may be very restricted due to the Danube, which acts as a physical barrier. Due to a lack of knowledge about the situation within Ukraine, the connection between the Romanian bears with those in the Slovak-Polish Carpathians is uncertain. There is already a gap along the Slovak-Polish border between the Bieszczady and

Tatra mountains where human infrastructures isolate the bears in western Slovakia. Furthermore the bears in the Apuseni Mountains in Romania are tenuously connected with the rest of Romanian Carpathians and the recent development of transportation infrastructure may cut them off completely.

Red List Category: LC (assuming some bears cross the various barriers)

Dinaric-Pindos: This ~3,000 bear population is shared by 9 countries, with an extent of occurrence of 115,300 km²: Slovenia (450), Croatia (1,000), Bosnia & Herzegovina (550), Montenegro (270), The Former Yugoslav Republic of (FYRO) Macedonia (180), Albania (180), Serbia (60), Kosovo: (unknown) and Greece (350). The northern portion of this population is close to the Alpine population; bears in the Italian Alps and Slovenia are weakly connected by male dispersers. However, there is not a continuous distribution of female bears within the Alps. Historical connections with the Carpathian population through Serbia and with the Eastern Balkans through the FYRO Macedonia are broken. In Slovenia, increasing human–bear conflicts are making it a challenge to maintain bear numbers at the present level, let alone allow for the spreading of the population into the Alps. With Croatia entering the EU, the status of bears was changed from "game species" to "fully protected". Hunting is now labeled culling and is justified under the EU derogation regulation, which has weakened hunters' support for bear management (Habitat Directive; http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01992L0043-20070101&from=EN). This population is shared by many countries and subject to widely varying monitoring methods and standards. There is a general lack of information from Bosnia & Herzegovina, Montenegro, Albania, Kosovo* and the FYRO Macedonia. There is no monitoring and no management plans in these countries. There appears to be limited or even no connectivity among portions of this population in Montenegro, Albania, Kosovo* and the FYRO Macedonia dividing the population into likely subpopulations, some of which continue to decline. There is a high likelihood of increased fracturing of this population and continued decline in important portions of the distribution.

* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence.

Red List Category: VU

Criteria: C2a(i)

Finnish-Karelian: About 2,000 bears are shared by Finland (1,900) and northern Norway (46) within 381,500 km². The Karelian population likely has some genetic exchange with the Scandinavian population to the south and west. This population is linked to the Baltic bear population via the large continental North Eurasian population (>100,000 bears) with bears in Belarus and Russia. Being part of this large population enhances their conservation status. However, the lack of reliable and regular information from Belarus or Russia makes it difficult to assess population or range changes.

Red List Category: LC (in connection with Russia west of 35°E)

Pyrenean: There are about 25 bears shared by France, Spain and intermittently Andorra, within an area of 17,200 km² in the Pyrenees Mountains. It has been totally isolated for over a century, and divided into western and central segments, with little interchange among these. The last female of Pyrenean ancestry died in 2010, leaving

the western segment with no females. The central segment has been growing since reintroductions from Slovenia in 1996–1997 and 2006, but genetically these are not Pyrenean bears. There is no possibility of re-establishing connectivity to any other population in the short term, and future reintroductions are in doubt, due to issues with human–bear conflicts. Some losses due to poaching or other human related accidents still occur.

Red List Category: CR

Criteria: D

Scandinavian: The bulk of this population resides in Sweden (3,300 bears) and the rest in south-central Norway (105), within 466,700 km² (Kindberg *et al*. 2011). The population is potentially connected with the Karelian population through dispersing males, but probably not females. The major pressure in Norway remains to the issue of damages to unguarded free-ranging sheep. This chronic conflict has led to parliament setting very low population targets goals for recovery. Although conflicts have been low in Sweden, new conflicts are appearing as bears expand into more densely populated areas to the south. However, generally the bear is well accepted and managed in Sweden.

Red List Category: LC

ASIA

The large north Eurasian (≈100,000) continental Brown Bear population is thought to be connected from Europe across Russia to Kamchatka. This population also extends eastward to the Finnish-Karelian population, and southward into north-eastern Kazakhstan, northern Mongolia and northeastern China. Other populations are found in Asia Minor, the Caucasus, the Middle East, South Asia, and Central Asia. The degree to which populations in Asia are inter-connected is not as well documented as in other parts of the world. However, genetic analysis suggests that the populations in the northern part of Asia have been isolated from populations in Central and South Asia for a long time.

Turkey and Middle East

Brown bears are found across much of Turkey and the Middle East, but populations appear highly fragmented. The following 13 populations have been identified.

Eastern Anatolia-Lesser Caucasus: Of the 3,400–4,000 bears found in Turkey, approximately 2000-2400 live in the 161,880 km² area of occupied habitat in the eastern Anatolia (Ambarli 2012, Ambarli *et al*. 2016). This population is connected to bears in a 5,800 km² portion of the Lesser Caucasus in Georgia (Lortkipanidze 2010, Ambarli and Kuşdili 2013) and perhaps to the Greater Caucasus via Surami/Likhi Ridge (Lortkipanidze 2010, Murtskhvaladze *et al*. 2010); however, roads and settlements have likely fragmented the populations in northeastern Turkey–Lesser Caucasus from bears in the Greater Caucasus. Furthermore, using mitochondrial DNA and microsatellite allele frequencies two genetically distinct maternal haplogroups have been identified (Murtskhvaladze *et al.* 2010). The genetic divergence between these haplogroups dates to the beginning of human colonization of the Caucasus and suggests little female

movement. The Eastern Anatolia–Lesser Caucasus population is likely connected to the population in northern Iraq (Kurdistan) and perhaps with the Zagros Mountains of Iran, but there is no evidence of female bear movements between these areas.

Brown Bear densities at least in one small area appear to be very high. In the upper Barhal River drainage near Yusufeli in the Eastern Anatolia Mountains, capture-recapture yielded estimates of 240–280 bears/1,000 km² (Ambarli and Kuşdili 2013), which is almost an order of magnitude higher than most brown bear populations in North American and Europe that do not have access to spawning salmon. The high density of bears was presumably due to access to numerous abandoned orchards and other human-developed foods. Remnant populations in this area may have been recovering for two decades (Ambarli 2012) as a consequence of a decline in the rural human population and newly introduced fines for killing bears, except for a controlled trophy hunt (No: 4,915, Official Gazette of Turkish Republic 2003, Ambarli and Bilgin 2008). This relatively stable population has >1,000 mature individuals.

Red List Category: LC

Greater Caucasus Mountains: Bears are found over approximately 82,700 km^2 in the Greater Caucasus. Population size estimates are poor or lacking for this area. However, using DNA analysis of feces in 2004 and 2005, Lortkipanidze (2010) estimated a minimum density of 13 bears/1,000 km² in a central portion of Georgia, and greatly varying estimates have been made for Azerbaijan. Based on these estimates, there are likely >1,000 mature bears in this population, but population trend is unknown.

Red List Category: NT

Criteria: D1

Kure Mountain-Western Black Sea, Turkey: The Kure Mountain population of Turkey, just south of the western Black Sea, covers about 18,000 km² and has an estimated 750-800 bears (Ambarli *et al*. 2016). This population is <5 km from the Western Anatolia population. Between these, however, is the fenced, six lane divided E80 highway and rural settlements and towns such as Kaynaşli and Yeniçağa. It is unlikely that female bears frequently cross this fracture, but there are viaducts and underpasses near Kaynaşli where bears may move. If they are connected or could be connected with some management actions, then there would be a joint population of >1,000 bears (Ambarli *et al*. 2015).

Red List Category: VU

Criteria: D1

Western Anatolia, Turkey: Perhaps 300-400 Brown Bears (165-220 mature bears) are found across approximately 23,300 km² in the western Anatolia Mountains. This population qualifies as EN if isolated, but if linked by female movement with the Kure Mountain-Western Black Sea population, would be VU.

Red List Category: EN

Criteria: D

Eastern Toros Mountains, Turkey: The Toros Mountains are in southern Turkey close to the Mediterranean Sea. There are thought to be two separate brown bear populations with the eastern population covering 11,800 km². Population size estimates are poor for this area but there are likely 50–250 mature individuals.

Red List Category: EN

Criteria: D

Western Toros Mountains, Turkey: Bears are found in the arc of mountains in the southwestern corner of Turkey in the Western Toros Mountains. They are found in an area of approximately 6,000 km² and there are likely between 50–250 mature individuals.

Red List Category: EN

Criteria: D

Aegean, Turkey: The Aegean population is very small (100-150 bears, Ambarli *et al*. 2016) and found over only 3000 km² in north western Turkey. It is possible that it is connected with the Western Anatolia population, but this is unknown.

Red List Category: CR

Criteria: D

Datca, Turkey: There is a very small population (<50 bears) in the extreme south western corner of Turkey on the Datca peninsula. It is thought that this population is isolated from the western Toros Mountains.

Red List Category: CR

Criteria: D

South Armenia-Iran: Another isolated area with brown bears is in the lesser Caucasus in south and eastern Armenia and into the Arasbaran Protected Area in northwestern Iran. In total, this area has approximately 25,600 km² of occupied bear habitat. The number of bears in Armenia is highly uncertain (Lortkipanidze 2010) but there is supposedly a “good population” (Malkhasyan and Kazaryan. 2012) with perhaps 100 brown bears in and near the 725 km² protected area in Iran (Gutleb *et al*. 2002). Although the total number of bears in this area is unknown, there are likely <250 mature individuals.

Red List Category: EN

Criteria: D

Aragats Mountain: This is a small, isolated population in the Lesser Caucasus of northwestern Armenia (Lortkipanidze 2010, Lortkipanidze pers. comm., 2014). Bears are found across perhaps 1,050 km² in the Aragats Mountains. Due to high level of disturbance and poaching it is not certain if bears remain in this area.

Red List Category: CR

Criteria: D

Mingacevir Reservoir: This is a small population in a semi-arid area of southestern Georgia and northern Azerbaijan, on the eastern part of Mingacevir Reservoir. The area covers about 3,900 km² but much is not fully occupied. Field work by Lortkipanidze (2010) suggested that there are perhaps 20 bears.

Red List Category: CR

Criteria: D

Zagros Mountains: Bears are found within a 34,000 km² area in the Zagros Mountains of western Iran and northern Iraq (Kurdistan), and some bears may move close to southeastern Turkey (Farhadinia, pers. comm., 2014; K. Ararat, pers. comm., 2014); however, much of this area is unlikely permanently occupied. The habitat is relatively poor (Gutleb *et al*. 2002) and bears likely range far. For example, in September 2013, a mother bear with two cubs were killed about 100 km east of the known population boundary, suggesting low densities may be found over a greater area. There appears to be five semi-isolated pockets of bears in these mountains that, together, span about 5,000 km². Gutleb *et al*. (2002) estimated <100 bears in the Zagros and K. Ararat guessed that 30–50 bears are present in the mountains of northern Iraq (Kurdistan).

Red List Category: EN

Criteria: D

Elburz Mountains: The Elburz Mountains along the south shore of the Caspian Sea is much better bear habitat than the Zagros Mountains: densities of >100 bears/1,000 km² have been reported (Gutleb *et al*. 2002). The mountain range appears to be occupied from Iran just into Azerbaijan (Gutleb *et al*. 2002, Lortkipanidze 2010), and into the Kopetdagh Mountains of Turkmenistan (but only few vagrant bears have been registered there during the 1980s–1990s; Red Data Book of Turkmenistan 2011). The total population is estimated at 1,300 (1,000–1,600) and thus likely has <1,000 mature individuals. It is believed to be stable or increasing.

Red List Category: VU

Criteria: D1

Central Asia

The degree of isolation of Brown Bear populations is uncertain within Himalaya, Karakorum-Pamir, Hissaro-Alai through to the Tian Shan Mountains and across Tibet. Genetic data are limited and very few bears have been radio collared and monitored in these areas. Although there are productive habitats in the west and northwest of this region (western parts of the Pamirs and Hissaro-Alai and western and northern Tien Shan), much of the habitat is high-elevation, often dry and poor compared to other areas where Brown Bears are found and consequently, densities are likely low. It is expected that over much of this area bears would have very large home ranges. Indeed, two male and one female with two cubs were fitted with GPS collars in 2011 in eastern Tibet and had home ranges of >7,000 and 2,200 km² respectively and crossed the 200-m wide

Yangtze River. Thus even female movements likely link populations over large areas (L. Wu, Liu Yanlin, pers. comm., 2014).

Western China (mostly Qinghai-Tibetan Plateau): The distribution of brown bears in southwestern China on the Qinghai-Tibetan Plateau (south and east of Taklimakan Desert and Tarim Basin) is fairly well documented although density and abundance are better viewed as guesses (Gong and Harris 2006). Information from a nationally-organized, broad-scale wildlife survey in the late 1990's suggested that brown bears occur across the Qinghai-Tibetan Plateau outside of broad, arid basins such as Dzungarian, Tarim, and Chaidam. The occupied area in western China may be as large as 2.4 million km². The population size is uncertain but a 2003 national survey estimated 6,300 bears (Gong and Harris 2006). The overall average density of 2.6 bears/1,000 km² is reasonable for a large area of relatively poor habitat. Estimates of trend are unknown but, based on accounts from the late 1880s to the 1930s, Schaller (1998) thought there was a decline, while some local officials believe numbers have recently increased. There are very few firearms in western China as they are generally illegal to own and rarely carried by enforcement officers (Gong and Harris 2006, Worthy and Foggin 2008) so few bears are shot. Widespread poisoning of pikas, a primary food of Tibetan bears, may have influenced bear populations although the effectiveness of the poison program is questionable (Gong and Harris 2006, Worthy and Foggin 2008). There are ongoing conflicts between semi-nomadic herders and bears, as bears frequently break into homes where the people are away on their summer ranges (L. Wu, pers. comm., 2014).

Red List Category: LC

Himalaya Mountains: Brown Bears are found in the upper Mustang valley (Aryal *et al*. 2012) and Manasalu Conservation Area in Nepal. These small areas are thought to be connected to the large, Tibetan population of brown bears and not isolated. A second population is found at higher elevations in the western Himalayas from mid Uttarakhand state in India, through the states of Himachal Pradesh and Jammu and Kashmir and into Pakistan. It is unknown whether this population is also connected to Tibet; Galbreath et al. (2007) argued, based on genetics, that there is an historic gap in the range that separates this subspecies (*U. a. isabellinus*) from the Tibetan subspecies (*U. a. pruinosus*). Nawaz (2007) suggests that these bears do not cross the upper Indus River into the Karakorum Mountains in Pakistan. Within Pakistan, there is a stable population of 40–62 bears in Deosai National Park (Bellemain *et al*. 2007, Abbas et al. 2015) and it is possibly linked to populations in India (Bellemain *et al*. 2007). In other portions of the Pakistan Himalayas, bear numbers are thought to be in decline and are likely fragmented (Nawaz 2007) into as many as nine or more groups that may be largely isolated (Abbas *et al*. 2015) and all but the Deosai population are thought to have <30 individuals (Abbas *et al*. 2015). Between Pakistan and India, there are an estimated 130–220 bears.

Red List Category: EN (if disconnected from Tibet, and all one population)

Criteria: D

Hindu Kush Mountains, Pakistan: Extensive field work using cameras and sign-surveys has improved the understanding of brown bear distribution in Pakistan since Nawaz (2007). It is now thought that there are 15–30 bears in an isolated area in the

Hindu Kush Mountains that is approximately 4,300 km² in size (Nawaz, pers. comm., 2014).

Red List Category: CR

Criteria: D

Karakorum, Pamirs and Hissaro-Alai Mountains: The boundaries of this population are vague, particularly in the east and north. It is possible that these bears are connected to the greater Tibetan population to the southeast of the Taklimakan Desert–Tarim Basin. Although the Fergana Valley to the north is considered here as a population boundary, it is possible that these populations are connected to the Tien Shan population near the Chinese border or throughout the Xinjiang. If the population is disconnected, the area that may be occupied by bears would be about 220,000 km². Not only are the boundaries uncertain, but so are the number of bears and trends in population size. Low densities of brown bears are found across the high and usually arid mountains of Pakistan, Afghanistan, western China (Xinjiang) and Tajikistan. Moderate to high densities of Brown Bears exist in habitats with higher productivity and more humid climate, for instance in the western and central parts of the Hissaro-Alai mountains and in the west of the Pamirs (e.g., in the Darvaz Range). Aromov (pers. comm., 2014) estimated that in the Gissar State Strict Nature Reserve in Uzbekistan, at the western edge of this population, bear numbers ranged from ~100–200. In the 1970s–1980s about 200–220 Brown Bears were thought to exist in Uzbekistan. Due to protection of this species, the population in the western Hissaro-Alai was thought to have increased to 500 individuals by 2009, with local densities of 100–300 bears/1,000 km² (Red Data Book of the Republic of Uzbekistan, 2009). In the Kugitang (Koytendag) Mountains in the East of Turkmenistan, a branch of the Hissaro-Alai mountain system, vagrant Brown Bears were recently recorded in 1995 (Red Data Book of Turkmenistan, 2011). In the Hissaro-Alai part of Kyrgyzstan the population is estimated to be 50 bears, and in Tajikistan about 500–700, but the reliability of these guesses is poor. With the relatively low density of bears expected in large parts of this area, there are possibly 500–1,500 bears, but likely less than 1,000 mature individuals.

Red List Category: VU

Criteria: D1

Tian Shan Mountains: As was the case in the other central Asian populations, there is uncertainty about bear populations in the Tian Shan Mountains of Kyrgyzstan, Kazakhstan, Uzbekistan, and Xinjiang (within China). These bears may be connected in the south (Fergana range and Alai range) to the population in the Hissaro-Alai, Pamir and Karakorum Mountains, but this is unknown. The Tian Shan bears are thought to be separated from bears in the Altay Mountains of northeastern Kazakhstan and Russia (Loginov 2012) by the Dzungarian Basin and less mountainous plains in northeastern Kazakhstan. Mountainous habitat that may be occupied by Brown Bears between the Fergana Valley and the Dzungarian Basin covers 200,000 km², but there could be further isolated pockets within this area. Loginov (2012) made a rough estimate of 195–255 (Loginov 2012; but one subpopulation seems missing) bears in the Kazakhstan portion of the Tian Shan area. For the Dzungarian Alatau no numbers are available, but Zhirjakov and Grachev (1993) state that at its northern slope, one of the densest bear populations occurs. Kyrgyz scientists (A. Davletbakov, A. Ostashenko, Kyrgyz National Academy of Sciences, and K. Jumabai uluu, Snow Leopard, Trust pers. comm., 2013)

guessed that about 150–250 bears are present in the Kyrgyz portion of the Tian Shan area. The numbers in this area are believed to have declined by about 60% over the last 30 years. Moderate bear densities are likely found in the Uzbekistan part of the western Tian Shan. Numbers might be in the range of about 100 bears (Red Data Book of the Republic of Uzbekistan 2009). Most of the area, however, is in Xinjiang and Kyrgyzstan, so the total number of bears would be substantially higher; but given the dry conditions in the eastern portion of this area, there is unlikely >1,000 mature animals.

Red List Category: VU

Criteria: D1

Western Kyrgyzstan: Brown Bears are found in the northwestern corner of Kyrgyzstan and across into the Ugam-Chatkal National Park area of Uzbekistan, and the Sairam-Ugam State National Natural Park and Aksu-Zhabagly Nature Reserve of southern Kazakhstan. The area of occupancy is not clearly defined but is likely about 20,000 km² of mostly mountainous terrain. The number of bears in this population is unknown, but, due to its size, there are will be less than 1,000 mature individuals and likely less than 250.

Red List Category: EN

Criteria: D

Gobi: The Brown Bear population in the Gobi Desert of southwestern Mongolia inhabit a 15,000 km^2 area that extends approximately 300 km east to west and 50 km north to south. An estimate of 22 bears (21–29, 95% CI) was obtained from a DNA hair sample survey in 2009 (Tumendemberel *et al*. 2015). These bears reside within portions of the Great Gobi Strictly Protected Area, established in 1975. Bear distribution in the GGSPA is associated with three oasis complexes, in three mountainous areas: Atas-Inges to the west, Tsagaan Bogd to the east, and Shar Khuls in the center. There are a minimum of 13 (and several more) springs associated with these oases complexes. DNA evidence showed that male bears move among all three oases complexes (250 km apart in total) indicating these bears comprise one population. Remote cameras, live capture for radio-collaring, and direct observation indicate that a minimum of 12 offspring were born during 1999–2012. Anecdotal reports suggest their distribution has shrunk from neighbouring mountains outside their current range since the 1970s. This is likely one of the most extreme physical environments of any brown bear population as this northern (43º latitude) high elevation (800–2,700 m) desert experiences extreme heat (+45°C), cold (-45°C), and dryness with <100–200 mm of precipitation annually.

These bears are completely isolated as evidenced by one of the lowest estimates of genetic diversity for brown bears (heterozygosity = 0.29, Tumendemberel, *et al*. 2015), only being greater than Kodiak Island and the East Cantarbrian Mountains in Spain (Skrbinsek *et al*. 2012). They are isolated to the north, east, and west by the low density herder-based human population with occasional villages or small towns. The closest bears to the north (500–800 km away) extend into northern Mongolia from Russia. Also, the Russian brown bear population extends into western Mongolia through eastern Kazakhstan approximately 500 km away. South into China the proximity of brown bears is more uncertain.

The Mongolian government supports brown bear conservation in the Gobi; they recently designated 2013 as the Year of the Gobi Bear. A research project, ongoing since 2005,

has been aimed at examining conservation status, limiting factors, reproductive characteristics, and ecology. Threats to their persistence include extreme small population size and limited genetic diversity limiting adaptation potential. Human-caused mortality appears minimal but threats do exist from illegal mining within the GGSPA, and the potential of larger scale proposed mining operations.

Red List Category: CR

Criteria: D

Hokkaido Island: The Island of Hokkaido, covering about 78,000 km², is inhabited by an estimated 2,200–6,500 Brown Bears. The population is thought to be increasing, according to a questionnaire survey of hunters (Hokkaido 2014). Also the bear distribution is expanding after the spring bear hunt was closed in 1990 (Mano 2006). There appears to be some fracturing on the island due to settlement and road building (Itoh *et al*. 2013). The degree of isolation is not certain nor is the size and trend of any isolated populations.

Red List Category: LC

Kunashiri Island: In 2001, the Hunting Department of Sakhalin Oblast estimated that 130 bears lived on the 1,490 km² Island of Kunashiri, the most southerly of the disputed (Russia and Japan) Kuril Islands. This Island is about 20 km from the much larger population in Hokkaido. Sato *et al*. (2011) estimated that about 10% of these bears have the white colour phase of the Ininkari bears, suggesting, along with the distance, that they are likely genetically isolated from bears in Hokkaido.

Red List Category: EN

Criteria: D

Etorofu (Iturup) Island: In 2001, The Hunting Department of Sakhalin Oblast estimated that 260 bears lived on the 6,725 km² Etorofu Island. This southern edge of this Island is about 22 km northeast of Kunashirir Island and also has the white, Ininkari bears (Sato *et al*. 2011).

Red List Category: EN

Criteria: D

Paramushir Islands: The two northern-most Kuril Islands (1 km apart) cover 2,050 km² and are 11 km from the southern tip of the Kamchatka Peninsula. Based on dispersal distances of brown bears on coastal Alaska, it is probable that bears on these islands are isolated. The population size is not known, but, based on the small area of the Islands, there are likely 50–250 mature individuals.

Red List Category: EN

Criteria: D

Citation: McLellan, B.N., Proctor, M.F., Huber, D. and Michel, S. (IUCN SSC Bear Specialist Group). 2016. Brown Bear (*Ursus arctos*) Isolated Populations (Supplementary Material to *Ursus arctos Redlisting* account). The IUCN Red List of Threatened Species 2016.

Literature Cited

Abbas, F., Bhatti, Z.I., Haider, J. and Mian, A. 2015. Bears in Pakistan: distribution, population biology and human conflicts. *Journal of Bioresource Management* 2: 1–13.

Ambarlı, H. 2012. Population status and conservation of brown bears in Turkey. Presentation in the Session of Asian Bears, 21st IBA Conference New Delhi, India, 2012.

Ambarli, H. and Bilgin, C.C. 2008. Human–brown bear conflicts in Artvin, northeastern Turkey: Encounters, damage, and attitudes. *Ursus* 19 (2):146–153

Ambarli, H. and Kuşdili, Y. 2013. Density estimation of a brown bear population by three noninvasive methods in Artvin, Turkey: implications for high density. In: 22nd International Conference on Bear Research and Management, 15–20 September 2013, Provo, UT, USA.

Ambarli, H., Erturk, A. and Soyumert, A. 2016. Current status, distribution, and conservation of brown bear (Ursidae) and wild canids (gray wolf, golden jackal, and red fox; Canidae) in Turkey. *Turkish Journal of Zoology* 40:1-13.

Apps, C., Paetkau, D., Rochetta, S., McLellan, B., Hamilton, A. and Bateman, B. 2009. Grizzly bear population abundance, distribution, and connectivity across British Columbia's southern Coast Ranges. Version 1.0. Aspen Wildlife Research and Ministry of Environment, Victoria, British Columbia.

Aryal, A., Hopkins III, J.B., Raubenheimer, D., Ji, W. and Brunton, D. 2012. Distribution and diet of brown bears in the upper Mustang Region, Nepal. *Ursus* 23:231-236.

Bellemain, E., Nawaz, M.A., Valentini, A., Swenson, J.E. and Taberlet, P. 2007. Genetic tracking of the brown bear in northern Pakistan and implications for conservation. *Biological Conservation* 34:537-547.

Bjornlie, D.D. Thompson, D.J., Haroldson, M.A., Schwartz, C.C., Gunther, K.A., Cain, S.L., *et al*. 2014. Methods to estimate distribution and range extent of grizzly bears in the Greater Yellowstone Ecosystem. *Wildlife Society Bulletin* 38:182–187.

Boyce, M.S. and Waller, J.S. 2003 Grizzly bears in the Bitterroot: predicting potential abundance and distribution. Wildlife Society Bulletin 31:670-683.

Galbreath, G.J., Groves, C.P. and Waits, L.P. 2007. Genetic resolution of composition and phylogenetic placement of the Isabelline Bear. *Ursus* 18:129-131.

Gärdenfors, U., Hilton-Taylor, C., Mace, G and Rodríguez, J.P. 2001. The application of IUCN Red List Criteria at Regional levels. *Conservation Biology* 15: 1206-1212.

Gervasi, V., Ciucci, P., Boulanger, J., Randi, E. and Boitani, L. 2012. A multiple data source approach to improve abundance estimates of small populations: the brown bear in the Apennines, Italy. *Biological Conservation* 152:10-20.

Gong, J. and Harris, R. 2006. The status of bears in China. *Understanding Asian bears to secure their future*. pp: 96-101. Japan Bear Network, Ibaraki, Japan.

Gutleb, B., Ghaemi, R.A. and Kusak, J. 2002. Brown bear in Iran. *International Bear News* 11:20.

Haroldson, M.A., Schwartz, C.C., Kendall, K.C., Gunther, K.A., Moody, D.S., Frey, K. and Paetkau, D. 2010. Genetic analysis of individual origins supports isolation of grizzly bears in the Greater Yellowstone Ecosystem. *Ursus* 21:1-13.

Haroldson, M.A., van Manen, F.T. and Bjornlie, D.D. 2013. Estimating number of females with cubs-of-the-year. Pages 11–18 *in* F. T. van Manen, M. A. Haroldson, and K. West, editors. Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2012. U.S. Geological Survey, Bozeman, Montana, USA

Hokkaido (2014) Hokkaido brown bear management plan. Hokkaido government, Sapporo, 40pp. (in Japanese)

Idaho's Yellowstone Grizzly Bear Delisting Advisory Team. 2002. State of Idaho Yellowstone grizzly bear management plan to accompany HRC 62. http://fishandgame.idaho.gov/public/wildlife/planGrizzly.pdf

Itoh, T., Sato, Y., Tsuruga, H., Mano, T., Kohira, M., Yamanaka, M., Kasai, S., Kobayashi, K. and Iwata, R. 2013. Estimating the population structure of brown bears in eastern Hokkaido based on microsatellite analysis. *Acta Theriologica* 58:127-138.

IUCN. 2001. Species Survival Commission. IUCN Red List Categories and Criteria.

IUCN. 2012. *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0*. Gland, Switzerland and Cambridge, UK: IUCN. iii + 41pp.

Kaczensky P., Chapron, G., von Arx, M., Huber, M., Andrén, C.H. and Linnell, J. 2013. Status, management and distribution of large carnivores – bear, lynx, wolf and wolverine – in Europe. Instituto di Ecologia Applicata and with contributions of the IUCN/SSC Large Carnivore Initiative for Europe (chair: L. Boitani) under EC contract N070307/2012/629085/SER/B3. pp72.

Kasworm, W.F., Proctor, M.F., Servheen, C. and Paetkau, D. 2007. Success of grizzly bear population augmentation in northwest Montana. *Journal of Wildlife Management* 71:1261–1266.

Kasworm W.F., Radandt, T.G., Teisberg, J.E., Proctor, M. and Servheen, C. 2013. Cabinet –Yaak grizzly bear recovery area 2012 research and monitoring progress report. US Fish & Wildlife Service Grizzly Bear Recovery Coordinator's Office, Missoula, Montana, USA.

Kendall, K.C., Macleod, A.C., Boyd, K.L., Boulanger, J., Royle, J.A., Kasworm, W.F., Paetkau, P., Proctor, M.F., Annis, K. and Graves, T.A. 2016. Density, distribution, and genetic structure of grizzly bears in the Cabinet-Yaak Ecosystem. Journal of Wildlife Management 80: 314-331.

Kindberg, J., Swenson, J.E., Ericsson, G., Bellemain, E., Miquel, C. and Taberlet, P. 2011. Estimating population size and trends of the Swedish brown bear *Ursus arctos* population. Wildlife Biology 17:114—123.

Linnell, J., Salvatori, V. and Boitani, L. 2008. Guidelines for population level management plans for large carnivores in Europe. A Large Carnivore Initiative for Europe report prepared for the European Commission (contract 070501/2005/424162/MAR/B2), Roma

Loginov, O. 2012. Status and Conservation of Two Brown Bear Subspecies in Kazakhstan. *International Bear News* 21: 24–26.

Lortkipanidze, B. 2010. Brown bear distribution and status in the South Caucasus. *Ursus* 21 97-103.

MacHutchon, A.G. and Proctor, M.F. 2014. Management plan for the Yahk and South Selkirk Grizzly Bear (*Ursus arctos*) sub-populations, British Columbia. Trans-Border Grizzly Bear Project, Kaslo, B.C. 95 pp.

Malkhasyan, A. and Kazaryan, A. 2012. Brown Bears in Armenia. *International Bear News* 21: 38-40.

Mano, T. 2006. The status of brown bears in Japan. In: *Understanding Asian bears to secure their future*. pp: 111-121. Japan Bear Network, Ibaraki, Japan.

Mattson, D.J. and Merrill, T. 2002. Extirpations of grizzly bears in the contiguous United States, 1850-2000. *Conservation Biology* 16:1123-1136.

McLellan, M.L. 2007. Ecological relationships between grizzly bears and forest management in the coast-interior transition of southern British Columbia: 2007 field season progress report. B.C. Ministry of Environment.

McLellan, B.N. and Hovey, F.W. 2001. Natal dispersal of grizzly bears. Canadian Journal of Zoology 79:838-844

Miller, S.D., White, G.C., Sellers, R.A., Reynolds, H.V., Schoen, J.W., Titus, K., Barnes Jr. V.G., Smith, R.B.R., Nelson, R., Ballard, W. and Schwartz, C.C. 1997. Brown and black bear density estimation in Alaska using radiotelemetry and replicated mark-resight techniques. *Wildlife Monographs* 133.

Ministry of Environment and Waters for Bulgaria. 2008. Action plan for the Brown Bear in Bulgaria. 86 p.

Montana Fish, Wildlife, and Parks. 2013. Grizzly bear management plan for southwestern Montana 2013. Final Programmatic Environmental Impact Statement. http://fwp.mt.gov/fishAndWildlife/management/grizzlyBear/grizPlan.html.

Moody, D.S., Hammer, M. Bruscino, D. Bjornlie, R. Grogan, and B. Debolt. 2005. Wyoming grizzly bear management plan. http://wgfd.wyo.gov/wtest/Departments/Wildlife/pdfs/WYGRIZBEAR_MANAGEMENTPLAN0000716.pdf

Mooney, P.W. 2007. Brown bear management report. Game Management Unit 4. P. Harper. Editor. Brown Bear Management Report on Survey-Inventory Activities. Alaska Department of Fish and Game.

Murtskhvaladze, M., Gavashelishvili, A. and Tarkhnishvili, D. 2010. Geographic and genetic boundaries of brown bear (*Ursus arctos*) population in the Caucasus. *Molecular Ecology* 19, 1829–1841. doi: 10.1111/j.1365-294X.2010.04610.x

Nawaz, M.A. 2007. Status of brown bear in Pakistan. Ursus 18: 89-100.

Paetkau, D., Shields, G.F. and Strobeck, C. 1998. Gene flow between insular, coastal, and interior populations of brown bears in Alaska. *Molecular Ecology* 7:1283-1292.

Proctor, M.F, McLellan, B.N., Strobeck, C. and Barclay, R.M.R. 2004. Gender specific dispersal distances for grizzly bears analysis revealed by genetic analysis. *Canadian Journal of Zoology* 82:1108-1118.

Proctor, M., Boulanger, J., Nielsen, S., Servheen, C., Kasworm, W., Radandt, T. and Paetkau, D. 2007. Abundance and density of Central Purcell, South Purcell, Yahk, and south Selkirk Grizzly Bear Population Units in southeast British Columbia. BC Ministry of Environment. Nelson, British Columbia, Canada.

Proctor, M.F., Paetkau, D., McLellan, B.N., Stenhouse, G.B., Kendall, K.C., Mace, R.D., Kasworm, W.F., Servheen, C., Lausen, C.L., Gibeau, M.L., Wakkinen, W.L., Haroldson, M.A., Mowat, G., Apps, C.D., Ciarniello, L.M., Barclay, R.M.R., Boyce, M.S., Strobeck, C. and Schwartz, C.C. 2012. Population fragmentation and inter-ecosystem movements of grizzly bears in western Canada and the northern United States. *Wildlife Monographs* 180:1-46.

Red Data Book of the Republic of Uzbekistan. 2009. Vol. 2. Animals. Tashkent.

Red Data Book of Turkmenistan. 2011. 3rd Edition. Vol. 2. Invertebrate and Vertebrate Animals. Ashgabat.

Romain-Bondi, K.A., Wielgus, R.B., Waits, L., Kasworm, W.F., Austin, M. and Wakkinen, W. 2004. Density and population size estimates for North Cascade grizzly bears using DNA hair-sampling techniques. *Biological Conservation* 117:417–428

Sato, Y., Nakamura, H., Ishifune, Y. and Ohtaishi, J. 2011. The white-colored brown bears of the Southern Kurils. *Ursus* 22:84-90.

Schaller, G.B. 1998. Wildlife on the Tibetan steppe. University of Chicago Press.

Schoen, J. and Beier, L. 1990. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Federal Aid in Wildlife Restoration Study 4.17. Alaska Department of Fish and Game, Juneau.

Schwartz, C.C., Haroldson, M.A., White, G.C., Cherry, S., Keating, K.A., Moody, D. and Servheen, C. 2006. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the greater Yellowstone Ecosystem. *Wildlife Monographs* 161:1–68.

Servheen, C. 1982. Grizzly bear recovery plan supplement: North Cascades Ecosystem Recovery Plan Chapter. US Fish and Wildlife Service. Missoula, Montana.

Servheen, C. 1997. Grizzly bear recovery plan supplement: North Cascades Ecosystem Recovery Plan Chapter. US Fish and Wildlife Service. Missoula, Montana.

Skrbinsek, T., Jelencic, M., Waits, L.P., Potocnik, H., Kos, I. and Trontelj, P. 2012. Using a reference population yardstick to calibrate and compare genetic diversity reported in different studies: an example from the brown bear. Heredity 109, 299–305.

Smith, R.B. and Van Daele, L.J. 1991. Terror lake hydroelectric project, Kodiak Island, Alaska, Final report on brown bear studies (1982- 1986). Alaska Department of Fish and Game, Juneau. AK.

Støen, O. Zedrosser, G.A., Sæbø, S. and Swenson, J.E.. 2006. Inversely density-dependent natal dispersal in brown bears *Ursus arctos. Oecologia* 148: 356–364.

Swenson, J.E., Sandergren, F. and Söderberg, A. 1998. Geographic expansion of an increasing brown bear population: evidence for presaturation dispersal. *Journal of Animal Ecology* 67:819–82

Tumendemberel, O., Proctor, M., Reynolds, H., Boulanger, J., Luvsamjamba, A., Tserenbataa, T., Batmunkh, M., Craighead, D., Yanjin, N. and Paetkau, D. 2015.

Gobi bear abundance and inter-oases movement survey, Gobi Desert, Mongolia. *Ursus,* In Press.

United States Fish and Wildlife Service. 1982. Grizzly bear recovery plan. U.S. Fish and Wildlife Service, Missoula, Montana, USA.

United States Fish and Wildlife Service. 1993. Grizzly bear recovery plan. U.S. Fish and Wildlife Service, Missoula, Montana, USA.

United States Fish & Wildlife Service. 2005. Endangered and threatened wildlife and plants; Designating the greater Yellowstone ecosystem population of grizzly bears as a distinct population segment; removing the Yellowstone distinct population segment of grizzly bears from the federal list of endangered and threatened wildlife. *United States Federal Register* 70:69854-69884.

United States Fish and Wildlife Service. 2007. Grizzly bears; Yellowstone distinct population; notice of petition finding; final rule. *United States Federal Register* 72:14866–14938.

Van Daele, L.J. and Crye, J.R. 2007. Unit 8. Pages 75-108 in, P. Harper. Editor. Brown Bear Management Report of Survey and Inventory Activities, 1 July 2004-30 June 2006. Alaska Department of Fish and Game. Juneau, Alaska.

Van Daele, L.J., Barnes Jr., V.G. and Belant, J.L. 2012. Ecological flexibility of brown bears on Kodiak Island, Alaska, *Ursus* 23:21-29.

Van Daele, M.B., Robbins, C.T., Semmens, B.X., Ward, E.J., Van Daele, L.J. and Leacock, W.B. 2013. Salmon consumption by Kodiak brown bears (*Ursus arctos middendorffi*) with ecosystem management implications. *Canadian Journal of Zoology* 91: 164-174

van Manen, F. T., Haroldson, M.A., Bjornlie, D.D., Ebinger, M.R., Thompson, D.J., Costello, C.M. and White, G.C. 2016. Density dependence, whitebark pine, and vital rates of grizzly bears. Journal of Wildlife Management 80:300-313.

Wakkinen, W.L. and Kasworm, W.F. 2004. Demographics and population trends of grizzly bears in the Cabinet–Yaak and Selkirk Ecosystems of British Columbia, Idaho, Montana, and Washington. *Ursus* 15:65-75.

Worthy, F.R. and Foggin, J.M. 2008. Conflicts between local villagers and Tibetan brown bears threaten conservation of bears in a remote region of the Tibetan Plateau. *Human-Wildlife Conflicts* 2:200-205

Zhirjakov, V.A. and Grachev, Y.A. 1993. Brown Bear. Central Asia and Kazakhstan. Pages 170–205 (including English translation) in M.A. Vaisfeld and I.E. Chestin, editors. Bears. Brown bear, polar bear, Asian black bear. Game animals of Russia and adjacent countries and their environment. Nauka, Moscow.

Zlatanova, D., Racheva V. and Fremuth W. 2009: Habitatverbund für den Braunbären in Bulgarien - Grundlage für die Schaffung Transeuropäischer Wildtiernetze (TEWN) auf dem Balkan. Naturschutz und Landschaftsplanung 41, (4). (In German).