Alligator Snapping Turtle Species Biological Status Review Report

November 12, 2015

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
620 South Meridian Street
Tallahassee, Florida 32399-1600

Biological Status Reviews
for
Alligator Snapping Turtles
(*Macrochelys* spp.)

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. In accordance with rule 68A-27.0012 Florida Administrative Code (F.A.C.), the biological review group (BRG) was charged with evaluating the biological status of the alligator snapping turtle (*Macrochelys temminckii*) using criteria included in definitions in 68A-27.001(3), F.A.C. and following protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. The original BRG concluded in 2010 that the alligator snapping turtle met criterion B2ab(iii), citing severe fragmentation of the population as part of the criterion (FWC 2011). However, FWC staff later evaluated the concept of "severely fragmented" and concluded that it did not apply to the alligator snapping turtle. When conducting the Regional Assessment, the BRG discussed that a rescue effect from turtles outside of Florida could occur if a catastrophic event in Florida eliminated populations of alligator snapping turtles. In these situations, the listing guidelines consider downgrading the initial listing finding. Taking into consideration both of these factors, staff recommended delisting the alligator snapping turtle (FWC 2011).

Since the original biological status review, Thomas et al. (2014) described 2 new species of alligator snapping turtle based upon genetic and skeletal differences, necessitating new biological status reviews of all 3 species. The Suwannee species (*M. suwanniensis*) is the most distinct and is apparently restricted to the Suwannee River basin. The Apalachicola species (*M. apalachicolae*) occurs from the Ochlockonee River basin west to the Choctawhatchee River basin. The nominate species (*M. temminckii*) occurs west of the Choctawhatchee River basin. On 11 November 2015, a second BRG met that consisted of Kevin Enge (FWC lead), Dale Jackson (Florida Natural Areas Inventory), Peter Meylan (Eckerd College), Paul Moler (independent consultant), and Travis Thomas (Nature Coast Biological Station). This new BRG concluded from the biological assessment that *M. suwanniensis* met 2 criteria. In Georgia, the Suwannee River has a small population size of alligator snapping turtles (Jensen and Birkhead 2003). Therefore, the rescue effect from turtles outside of Florida would be minimal except possibly from its tributary, the Withlacoochee River. The BRG decided that the rescue effect from Georgia is unknown. Taking into consideration both of these factors, staff recommends listing *M. suwanniensis* as threatened. The BRG concluded from the biological assessment that *M. apalachicolae* did not meet any criteria. Staff recommends not listing *M. apalachicolae*. The BRG concluded from the biological assessment that *M. temminckii* met 1 criterion. The BRG decided that a rescue effect is possible from *M. temminckii* outside of Florida, because populations occur upstream in the Escambia (called Conecuh River in Alabama) and Yellow River, but the extent of immigration of turtles from Alabama is unknown. Staff concluded that the BRG provided insufficient evidence to support a projected decline in habitat due to sea level

rise or degraded water quality in the next 90 years (3 generations), which was the subfactor for meeting criterion B. Therefore, taking into consideration the potential for a rescue effect and the uncertainty of the threat of sea level rise or degraded water quality, staff recommends not listing *M. temminckii*.

BIOLOGICAL INFORMATION

Taxonomic Classification – Thomas et al. (2014) described 2 new species of alligator snapping turtle, *M. apalachicolae* and *M. suwanniensis*, based upon genetic differentiation and differences in skull and carapace morphology. This taxonomic arrangement recognizes the 3 genetic lineages previously identified by Roman et al. (1999) and Echelle et al. (2010). The Suwannee lineage was the most distinct both genetically and morphologically (Thomas et al. 2014). There has been disagreement as to whether the Apalachicola lineage warrants designation as a distinct species (Folt and Guyer 2015).

Life History and Habitat Requirements – Life history and habitat requirements of alligator snapping turtles (*Macrochelys* spp.), which are restricted to rivers and associated permanent freshwater habitats, have been summarized by Ewert et al. (2006), Pritchard (2006), and Ernst and Lovich (2009). Habitats include channels and deep holes in rivers and the numerous streams in floodplain swamp forests characterized by tannic or turbid waters, bald cypress and tupelo (Ewert and Jackson 1994). The only lakes typically supporting the species are either impounded sections of large rivers (Lake Seminole: Apalachicola, Lake Talquin: Ochlockonee) or natural lakes with at least occasional connection to a river (e.g., Lake Iamonia, Leon County). However, Johnston et al. (2015) trapped a turtle in an isolated sinkhole lake. *Macrochelys* can inhabit surprisingly small sand-bottomed streams, such as the seepage streams on Eglin Air Force Base, provided abundant logs and deep bends with undercut banks are present (Moler 1996). A few adults have been taken from brackish water habitats (e.g., Ochlockonee and Apalachicola bays), with some individuals even supporting barnacles, but movements into salt water are extremely rare (Ewert et al. 2006, Pritchard 2006).

All 3 species presumably have similar life history and habitat requirements in Florida, and Moler (1996) found similar habitat use during a distributional survey conducted in Florida. Recent population studies have been conducted on *M. suwanniensis* in Florida in the Suwannee River from White Springs to the mouth (Enge et al. 2014b) and in the Santa Fe River, a major tributary (Johnston et al. 2015). Turtles were most abundant in the middle section of the Suwannee River, where input of ground water from springs and riverbed leakage increased the productivity and changed the water chemistry of the blackwater stream; only 1 turtle was captured at the 2 estuarine sites (Enge et al. 2014b). Ewert and Jackson (1994) studied *M. apalachicolae* in the Apalachicola River. No population studies have been conducted on *M. temminckii* in Florida, but numerous studies have been conducted in other states.

The alligator snapping turtle is the largest North American freshwater turtle, with males (up to 250 lbs, 29 inch carapace length [CL]) growing considerably larger than females (maximum ≈62 lbs, 22 inches CL) (Ewert et al. 2006, Pritchard 2006). Upper and lower reaches of the Suwannee River had an equal sex ratio, whereas males outnumbered females more than 4:1 in the 3 middle reaches, which also had significantly more large male turtles (Enge et al.

2014b). Johnston et al. (2015) divided the Santa Fe River into upper and lower sections that are separated by a natural limestone bridge where the river flows underground for ≈5 km. The upper river is a blackwater stream, but input of clear, thermally stable, mineral-rich water from numerous artesian springs affects the lower section of the river. The upper Santa Fe River had a female-biased sex ratio, but the lower river had an equal sex ratio (Johnston et al. 2015). Juveniles comprised 21%, adult females 17%, and adult males 61% of the sample (N = 161) in the Suwannee River. Juveniles comprised 24%, adult females 44%, and adult males 32% of the sample (N = 109) in the Santa Fe River. Thirty-three of 81 (41%) adult males in the Suwannee River weighed at least 45 kg, and the largest male weighed 57 kg. Adult females were significantly larger in the upper Santa Fe River than the lower Santa Fe River, but male size did not differ between river sections, although the 6 largest males (> 600 mm CL) came from the lower section. Compared to other studies on *Macrochelys*, the study in the Suwannee River is the only one with a sex ratio biased towards males and with a preponderance of large adult males, possibly because commercial harvest was limited.

Sonic telemetry of 20 turtles at 1 site in the upper reach and 1 site in the middle reach of the Suwannee River found that males had a much larger mean minimum linear home range (3,986 m) than females (2,061 m), but the difference between sexes or reaches was not statistically significant (Enge et al. 2014b). Adjusted linear home ranges, which eliminate the outlier locations, were more similar between sexes. Turtles primarily used woody debris, which was the most available cover, but undercut banks were preferentially selected. During low water levels, woody debris in the river channel became more important. During high water levels, turtles often foraged in inundated floodplains, and some turtles continued moving between the floodplain and river channel after water levels fell and they had to travel over land. All turtles in the Suwannee River had a mean of 4 core activity sites (range 2–8) ≈300 m apart. Turtles were sedentary during the day and became active at night, exhibiting year-round activity.

Dobie (1971) claimed that both sexes in Louisiana attained sexual maturity in 11–13 years, but other researchers claim sexual maturity requires 13−21 years in females and 11−21 years in males (Sloan et al. 1996, Tucker and Sloan 1997). Life span in the wild is unknown, but a turtle caught as an adult lived 70 years in captivity (Snider and Bowler 1992). Based on these data, a conservative estimate of average age of parents (generation time) is 30−40 years. Reed et al. (2002) estimated generation time at 49 years. All studies (e.g., Allen and Neill 1950, Dobie 1971, Ewert and Jackson 1994) indicate that females produce but one clutch per year, and some may occasionally skip years (Dobie 1971). The nesting season is correspondingly short, extending from late April to mid-May in Panhandle Florida (Ewert and Jackson 1994). Nests along the Apalachicola River were constructed in sandy soils when available, normally within 20 m of water but sometimes as far as 200 m (Ewert and Jackson 1994). Natural berms 2−3 m high were favored along the lower Apalachicola River, but these have been supplemented and in part replaced by man-made deposits of sandy dredged spoil, which are warmer and tend to produce more female hatchlings as a consequence of temperature-dependent sex determination (Ewert and Jackson 1994). Clutch sizes of *M. apalachicolae* along the lower Apalachicola River, the best studied site, averaged ≈36 eggs (range 17−52). Two salvaged *M. suwanniensis* clutches contained 43 and 47 eggs (Thomas, unpubl. data). Hatching along the Apalachicola River occurred in the second half of August after 100−110 days of incubation, followed within a few weeks by hatchling emergence (Ewert and Jackson 1994).

Macrochelys has been reported to eat fish, crustaceans, mollusks, insects, aquatic salamanders, snakes, turtles, small alligators (*Alligator mississippiensis*), birds, mammals, and plant material, which may include quantities of grapes, acorns, and palmetto and tupelo fruits (Allen and Neill 1950, Dobie 1971, Sloan et al. 1996, Harrel and Stringer 1997, Elsey 2006, Pritchard 2006). Adults apparently are opportunistic scavengers (Elsey 2006), but juveniles feed predominantly upon small fishes, which are often lured into striking distance by wriggling a pink, worm-like structure that extends from the tongue (Spindel et al. 1987, Pritchard 2006).

Population Status and Trend – Enge et al. (2014b) used mark-recapture data to derive an estimate of population abundance of *M. suwanniensis* for each ecological reach of the Suwannee River and then determined a rough population estimate excluding the estuary, which had too few captures. They estimated 780−1,171 adult turtles (95% Confidence Interval) inhabit the Suwannee River, not including its tributaries, between White Springs and the estuary. Estimated population densities in the Suwannee River ranged from 1.68 adults/km in the reach farthest upstream to 4.33 adults/km in one of the middle reaches. Excluding the estuary, an average of 0.25 turtles were captured per trap night. Identical trapping methods for *M. apalachicolae* in 2014 (≈100 trap nights per river) yielded 0.35 turtles per trap night at 2 sites along the Apalachicola River, 0.53 turtles per trap night at 2 sites along the Ochlockonee River, and 0.01 turtles per trap night at 2 sites along the Choctawhatchee River (Mays et al. 2015). The Choctawhatchee River appeared to have suitable habitat for *M. apalachicolae*, but Moler (1996) also failed to trap the species there in 12 trap nights. The species has never been found in the Alabama portion of the Choctawhatchee drainage (Folt and Godwin 2013). However, 1 juvenile turtle was observed basking in 2014 along the Choctawhatchee River (Mays and Hill 2015), and Moler (1996) trapped 2 turtles in 41 trap nights in Holmes Creek, the major Florida tributary of the Choctawhatchee River. The most productive trapping sites that Moler (1996) recorded for *M. temminckii* were the upper Escambia River (1.25 turtles per trap night).

Based upon abundance and an age structure that includes a high percentage of large turtles, particularly males, the Suwannee River drainage in Florida apparently experienced relative little historical harvest (Enge et al. 2014b, Johnston et al. 2015). Large *M. apalachicolae* are present in the Apalachicola and Ochlockonee rivers (Moler 1996, Thomas, unpubl. data), and large *M. temminckii* are present in the Escambia River (Moler 1996). Population studies in rivers where *Macrochelys* were heavily harvested showed female-biased or equal sex ratios and a preponderance of juveniles (Jensen and Birkhead 2003, Boundy and Kennedy 2006, Riedle et al. 2008, Howey and Dinkelacker 2013, Lescher et al. 2013). After periods of heavy harvesting effort, declining yields typically forced commercial trappers to move on to other sites (Pritchard 2006). This is not unexpected given the long generation time of alligator snapping turtles and the normally low rates of recruitment of virtually all turtles.

Beginning in 1973, enactment of a series of protective rules by FWC (then the Florida Game and Fresh Water Fish Commission [GFC]) reduced the species' rate of decline in Florida, although harvest (legal and illegal) still occurred. Recent FWC rule changes (2009) prohibited take of all snapping turtles and ended legal harvest. *Macrochelys* populations are apparently secure in most Florida rivers, because harvest is now prohibited; water management areas and

other conservation lands preserve habitat and restrict development along rivers and in floodplains.

Geographic Range and Distribution – *Macrochelys suwanniensis* is restricted to the Suwannee River basin (Fig. 1), which includes the Withlacoochee and Santa Fe/New rivers (Fig. 2, Table 1). A few alligator snapping turtles have been reported from the Aucilla, St. Marks, and Wakulla rivers between the Suwannee and Ochlockonee rivers, but there is no evidence that viable populations occur in these rivers (Jackson 2002, Enge et al. 2014a). The range of *M. apalachicolae* extends from the Ochockonee River basin west to the Choctawhatchee River basin (Fig. 1). Besides these 2 rivers, it is found in 7 discrete streams: Apalachicola River, Econfina Creek, New River, Sandy Creek, Sopchoppy River, Turkey Creek, and Wetappo Creek. It also occurs in 4 major tributaries: Chipola River, Holmes Creek, Juniper Creek, and Telogia Creek (Fig. 3, Table 1). The Florida range of *M. temminckii* is west of the Choctawhatchee River basin as far as the Perdido River (Fig. 1), and its entire range extends as far west as the Trinity River in eastern Texas and north in the Mississippi River drainage to southeastern Iowa. This species inhabits 6 discrete Florida rivers: Blackwater River, East Bay River, Escambia River, Perdido River, Pond Creek, and Yellow River. It also inhabits 2 major tributaries: Big Coldwater Creek and Shoal River (Fig. 4, Table 1).

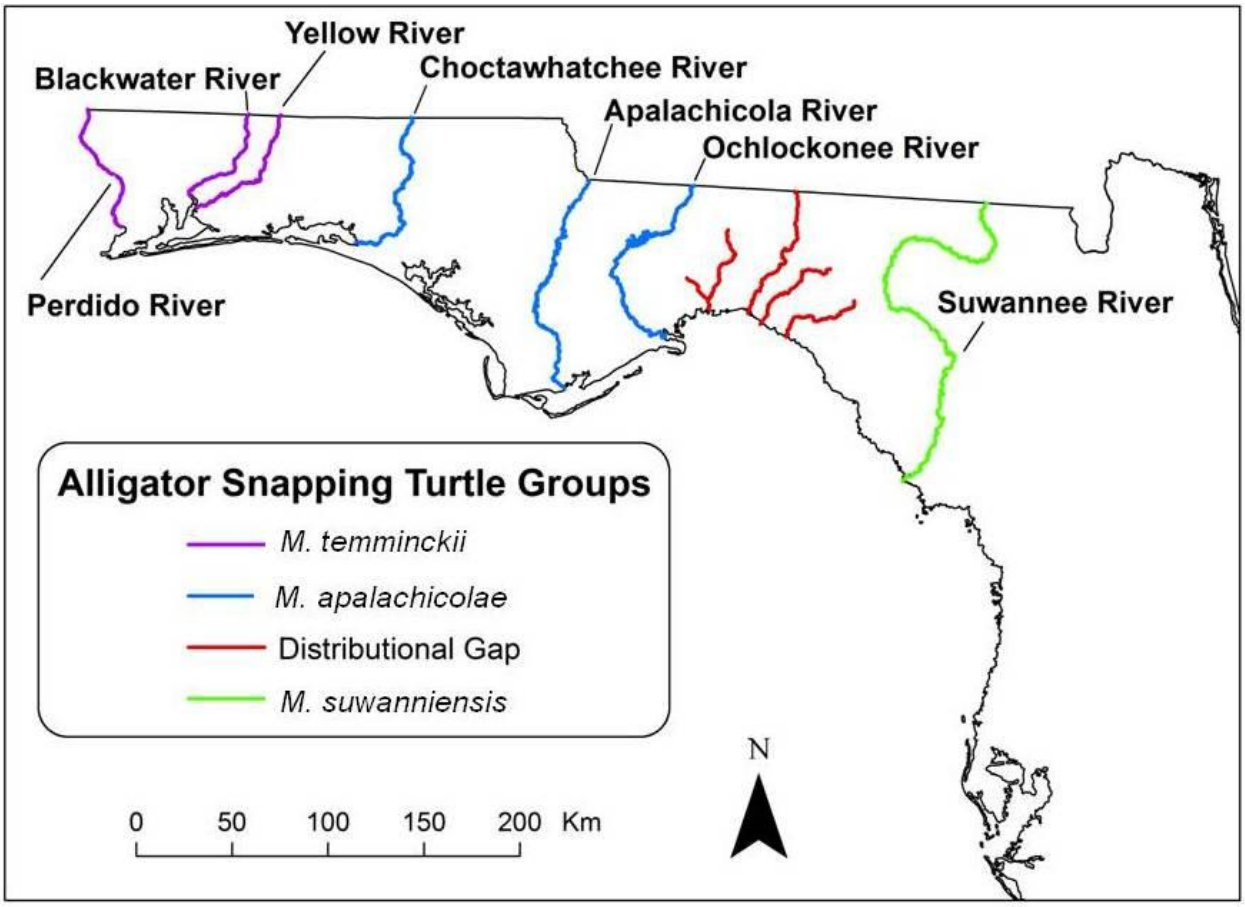

Fig. 1. Distribution of *Macrochelys* spp. in Florida (from Thomas et al. 2014b).

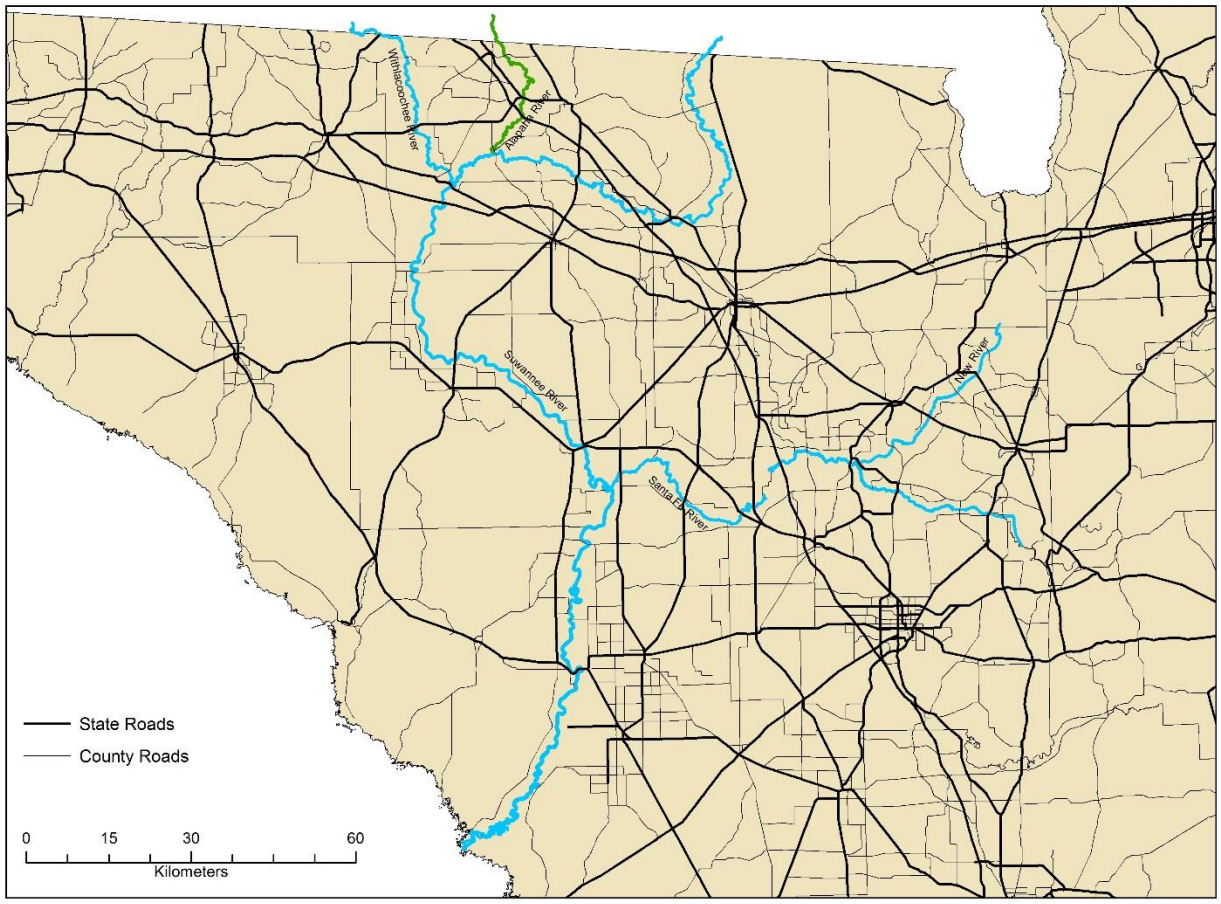

Fig. 2. Rivers and streams that are considered locations for *Macrochelys suwanniensis* (blue) or are possible locations, if enough turtles are present for long-term viability (green).

Quantitative Analyses – The principal attempt at modeling population demography of the alligator snapping turtle and evaluating population effects of changes in life-history parameters is that of Reed et al. (2002). They concluded that 1) annual survival rate of 98% for adult females was necessary for population stability, 2) any lesser rate would lead to long-term population decline and eventual extirpation, and 3) even successful efforts to increase egg and juvenile survival would be unlikely to compensate for continued loss of adult females. The model may have underestimated the rates of nest and/or juvenile survival in the wild, leading to an overestimate of necessary female survival rate (Ewert et al. 2006).

Fig. 3. Rivers and streams that are considered locations for *Macrochelys apalachicolae* (blue) or are possible locations, if enough turtles are present for long-term viability (green).

BIOLOGICAL STATUS ASSESSMENT

Threats –The alligator snapping turtle has a long history of both commercial and personal harvest for meat throughout its range, including in Florida (Dobie 1971, Sloan and Lovich 1995, Reed et al. 2002, Ewert et al. 2006, Pritchard 2006). Beginning in the 1970s, rules enacted by the GFC to limit take likely slowed the rate of mortality in Florida, though both legal and illegal harvest still occurred. Legal take of alligator snapping turtles was prohibited by rule changes enacted by FWC in 2009. Anecdotal evidence and trapping data suggest that the Suwannee alligator snapping turtle was not heavily harvested in Florida. However, bycatch mortality on lines set for fish, especially catfish, remains a problem. These include both trot lines (long lines of submerged baited hooks) and bush lines (single hooks suspended from tree branches) (Ewert et al. 2006, Pritchard 2006). The latter may be more widely used in rivers and hence likely present a greater problem for the alligator snapping turtle. Three of 25 radiographed turtles from the Suwannee River had ingested fish hooks, and 1 turtle contained 3 hooks (Enge et al. 2014b). The impact of these hooks and their attached fishing line on turtle survival is unknown.

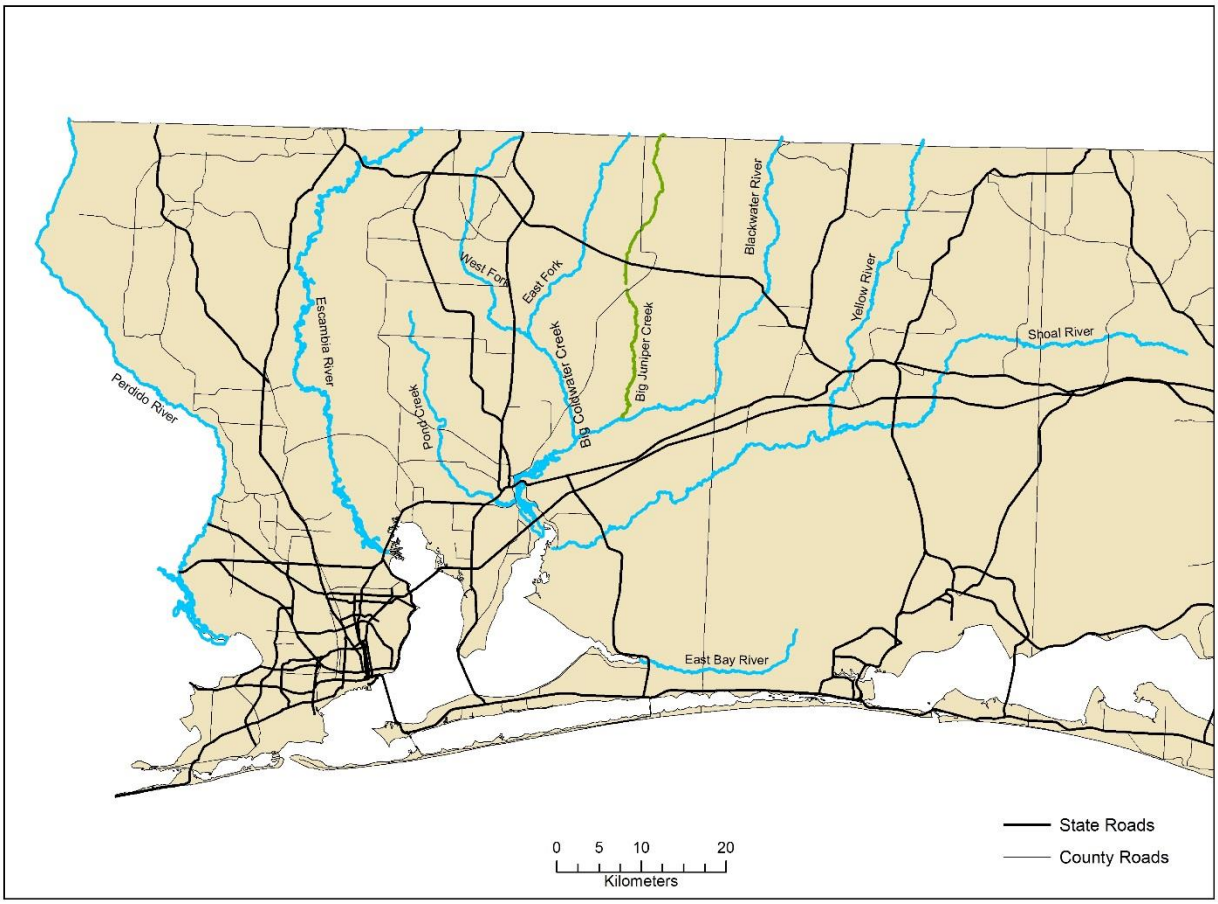

Fig. 4. Rivers and streams that are considered locations for *Macrochelys temminckii* (blue) or are possible locations, if enough turtles are present for long-term viability (green).

Because rivers tend to be relatively stable and persistent systems compared to most Florida habitats, outright habitat destruction is not a major threat to this turtle. Nonetheless, various human-generated insults to the integrity of lotic systems, including their floodplains, can and do affect Florida's riverine turtles (Jackson 2005). Chemical pollution (from industries such as pulp mills, and waste products from cities and agricultural activities, including those in Alabama and Georgia) always poses a potential threat to riverine fauna, though even a major spill along one Panhandle river would not endanger the species' statewide population (Ewert et al. 2006). As for all turtles, predation (particularly by raccoons) accounts for the loss of most alligator snapping turtle eggs (about 2/3 along the lower Apalachicola River). Additional potential predators include wild hogs and imported fire ants. Nest flooding following very heavy regional rains also destroys entire clutches in some years (Ewert and Jackson 1994).

Table 1. Rivers and large streams presumably inhabited by *Macrochelys* spp. in Florida from east to west. A stream is considered a "location" if a major road crossing is present near its headwaters that would make it susceptible to a toxic spill or if it has its own subpopulation. If the presence of *Macrochelys* in a stream is suspected but not confirmed or if sufficiently large numbers of turtles may not be present for long-term viability, the stream is considered an "unknown" location.

Species	Discrete Drainage	Tributary	Location?
M. suwanniensis	Suwannee		Yes
		Santa Fe River	Yes
		New River	Yes
		Alapaha River	Unknown
		Withlacoochee River	Yes
M. apalachicolae	Sopchoppy River		Yes
	Ochlockonee River		Yes
		Little River	Unknown
		Telogia Creek	Yes
	New River		Yes
	Apalachicola River		Yes
		Chipola River	Yes
		Juniper Creek	Yes
	Wetappo Creek		Yes
	Sandy Creek		Yes
	Bear Creek		Unknown
`	Econfina Creek		Yes
	Choctawhatchee		Yes
		Holmes Creek	Yes
		Wrights Creek	Unknown
	Black Creek		Unknown
	Alaqua Creek		Unknown
	Rocky Creek		Unknown
	Turkey Creek		Yes
M. temminckii	East Bay River		Yes
	Yellow River		Yes
		Shoal River	Yes
	Blackwater River		Yes
		Big Juniper Creek	Unknown
		Big Coldwater Creek	Yes
	Pond Creek		Yes
	Escambia River		Yes
	Perdido River		Yes

Statewide Population Assessment – Findings from the BRG are included in the Biological Status Review Information tables, but the pertinent information is summarized below.

The BRG found that *M. suwanniensis* has a limited geographic range (Criterion B) both in extent of occurrence (B1) and area of occupancy (B2). The Suwannee River basin occurs in 11 counties that have a total area of 15,581 km^2, which is less than the 20,000 km^2 limit for extent of occurrence. The area of rivers inhabited is < 2,000 km^2, which is the limit for area of occupancy. In order to meet the criterion of being threatened due to geographic range (B), a species also has to meet at least 2 of 3 subcriteria. The Suwannee alligator snapping turtle does not meet the subcriterion of being severely fragmented, because it probably consists of 2 subpopulations, which are defined as "*geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less)*" (IUCN 2010). Freshwater species occurring in more than 1 body of water have naturally fragmented distributions, but the BRG did not interpret this as being "severely fragmented." The 5-km land bridge between the upper and lower Santa Fe River probably divides subpopulations, whereas frequent gene flow probably occurs between the Suwannee River and its tributaries. Alligator snapping turtles have limited terrestrial mobility, and the land bridge probably restricts gene flow between the subpopulations except during extreme flood events. Johnston et al. (2015) reported a secondhand observation of an adult turtle walking in shallow water over the land bridge during flooding. However, the species does meet Subcriterion (a) by occurring in $\leq$ 10 locations. A location is defined as "*a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present*" (IUCN 2010). The Suwannee species inhabits the Suwannee River and 3 major tributaries, the New, Santa Fe, and Withlacoochee rivers, which total 4 locations (Fig. 3). The BRG did not include the Alapaha River, another tributary, as a location (Table 1) because portions of the river periodically dry up and the species has not been documented in Florida. The species has been documented from the Alapaha River in Georgia, but trapping rates were low (0.04 turtles/trap night) (Jensen and Birkhead 2003), and relatively few turtles may be present in the Florida portion of the river. This species apparently does not inhabit the 7 rivers in the Big Bend region between the Suwannee and Ochlockonee rivers (Jackson 2002, Enge et al. 2014a), but even if viable subpopulations occurred in most of these rivers, the total would still be 10 locations or fewer. "*Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat(s)*" (IUCN 2010). The BRG decided that the most plausible threat would be a toxic chemical spill at a highway/railroad crossing or in a city near the headwaters that would rapidly affect all downstream turtles. Tanker transport of chemicals would be most likely to occur on paved roads or major dirt roads, so a road crossing by a minor dirt road would not pose a plausible potential threat. When parts of a taxon's distribution are not affected by any threat, other options are available to determine the number of locations. The most appropriate option for streams not threatened by toxic spills is the "*number of locations in the unaffected areas is set to the number of subpopulations in those areas*" (IUCN 2010). A discrete stream without a road crossing near its headwater can be counted as a location, whereas a major tributary without a road crossing would not meet the definition of a location because its subpopulation is shared with the main river. For example, the Ichetucknee River, a springfed tributary of the Santa Fe River without a road crossing near its headwaters, is not counted as a location. Turtles occur in additional smaller tributaries with road crossings that could be considered locations, but the BRG elected not to include these tributaries if too few turtles were suspected to be present to constitute a viable subpopulation if all turtles in the main

river were extirpated. Similarly, small discrete streams were not counted as locations if the presence of turtles were unknown or if the BRG suspected that numbers were too low to allow long-term survival of the subpopulation if adjacent subpopulations were extirpated (i.e., rivers draining into the same bay). The second subcriterion met is (b) (iii), a continuing decline is inferred or projected in area, extent, and/or quality of habitat. Projections for sea level rise causing increased salinity near the Gulf of Mexico and future declines in water quality (pollution) and quantity (increased human demand for water from the Suwannee River or the Floridan Aquifer) could result in declines in area and quality of habitat. *Macrochelys suwanniensis* also meets Criterion D regarding a very small or restricted population. The species meets Sub-criterion D2 because it has 5 or fewer locations (Suwannee, New, Santa Fe, and Withlacoochee rivers) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future.

The BRG found that *M. apalachicolae* has a limited geographic range (Criterion B) both in extent of occurrence (B1) and area of occupancy (B2). The approximate range of the species extends from Holmes Co. and half of Walton Co. east to Leon and Wakulla counties, which totals 13,714 km^2 (< 20,000 km^2 limit for extent of occurrence). The area of rivers inhabited is < 2,000 km^2, which is the limit for area of occupancy. In order to meet the criterion of being threatened due to geographic range, a species also has to meet at least 2 of 3 subcriteria. The species does not meet Subcriterion (a) because it occurs in > 10 locations. It inhabits 9 discrete rivers and 4 major tributaries that can be considered locations (Fig. 3, Table 1). Turkey Creek lacks a road crossing near its headwaters and would not be susceptible to a toxic spill, but it is considered a location because it is a discrete stream with its own subpopulation. Turtles probably occur in additional smaller streams and tributaries that could be considered locations, such as the Little River and Bear, Wrights, Black, Alaqua, and Rocky creeks (Fig. 3, Table 1), but the BRG was either unaware whether turtles were present or whether sufficient numbers were present to ensure long-term subpopulation viability. Although turtles have limited ability to make overland movements between river drainages or saltwater movements between bays, the population is not severely fragmented because the Apalachicola and Ochlockonee subpopulations (and possibly others) are large. This species meets Subcriterion (b) (iii), a continuing decline is inferred or projected in area, extent, and/or quality of habitat. Projections for sea level rise causing increased salinity near the Gulf of Mexico and future declines in water quality and quantity (increased human demand for water and increased pollution from cities, industries, and agriculture) could result in declines in area and quality of habitat.

The BRG found that *M. temminckii* has a limited geographic range (Criterion B) both in extent of occurrence (B1) and area of occupancy (B2). The approximate range of the species encompasses Escambia, Santa Rosa, Okaloosa, and half of Walton Co., which totals 8,145 km^2 (< 20,000 km^2 limit for extent of occurrence). The area of rivers inhabited is < 2,000 km^2, which is the limit for area of occupancy. In order to meet the criterion of being threatened due to geographic range, a species also has to meet at least 2 of 3 subcriteria. The species meets Subcriterion (a) by occurring in $\leq$ 10 locations. This species inhabits 6 discrete rivers and 2 major tributaries that have paved road crossings near their headwaters and are thus susceptible to toxic spills (Fig. 4, Table 1). Turtles occur in additional smaller streams and tributaries that could be considered locations, such as Big Juniper Creek (Fig. 4), but the BRG elected not to include these tributaries because either the presence of turtles was unknown or sufficient

numbers may not be present for long-term survival of the subpopulation if all turtles in the main river were extirpated. Although turtles have limited ability to make overland movements between river drainages or saltwater movements between bays, the population is not severely fragmented because some of the subpopulations, such as the Escambia and Blackwater rivers are presumably large based upon trapping results (Moler 1996) and river size. The second subcriterion met is (b) (iii), a continuing decline is inferred or projected in area, extent, and/or quality of habitat. Projections for sea level rise causing increased salinity near the Gulf of Mexico and future declines in water quality and quantity (increased human demand for water and increased pollution from cities, industries, and agriculture) could result in declines in area and quality of habitat.

When conducting the Regional Assessment (following), the BRG discussed whether a rescue effect from turtles outside Florida could occur if a catastrophic event in Florida eliminated populations of *Macrochelys.* In these situations, the listing guidelines consider downgrading the initial finding. *Macrochelys suwanniensis* is apparently scarce in the Georgia portion of the Suwannee River (Jensen and Birkhead 2003), so any rescue effect may take a long time. Pritchard (1989), citing mainly park naturalists in Florida and Georgia, reported *Macrochelys* was scarce in the Suwannee River and its headwaters, the Okefenokee Swamp. Intensive trapping in Georgia failed to detect the species in the upper Suwannee River, possibly due to natural rarity, low pH and its effect on prey items, or impacts associated with commercial harvest (Jensen and Birkhead 2003). However, a rescue effect from the Georgia portion of the Withlacoochee River might occur. *Macrochelys apalachicolae* might experience a rescue effect from Georgia in the Ochlockonee River. Jensen and Birkhead trapped 0.15 turtles captured per trap night in the Georgia portion of the Ochlockonee River. Any rescue effect from Georgia in the Apalachicola River is compromised by the Jim Woodruff Dam that is located on the Florida/Georgia border ≈300 m downstream of the river's origin at the confluence of the Chattahoochee and Flint rivers. A trapping study in Georgia in the Apalachicola drainage found them to be abundant (0.45 turtles per trap night) in the Apalachicola and 2 of its tributaries, Chattahoochee River and Spring Creek (Jensen and Birkhead 2003). However, populations were apparently low (0.08−0.09 per trap night) in the Flint River, which experienced heavy commercial harvest in the past (Jensen and Birkhead 2003, King and Smith 2014). Records are lacking from the Alabama portion of the Choctawhatchee River (Folt and Godwin 2013), and any rescue effect would be nonexistent or negligible. Some Florida rivers inhabited by *M. temminckii* do not extend into Alabama, but a rescue effect might be expected in the Escambia River (named Conecuh River in Alabama) and possibly the Yellow River, but the BRG did not know whether a significant number of turtles would immigrate. A recent distributional survey in southern Alabama trapped turtles in the Conecuh River (0.30 turtles per trap night) (Folt and Godwin 2013). The Yellow River was not trapped in Alabama, but historical records exist from there (Folt and Godwin 2013). The species also occurs in the Perdido River, which comprises the Alabama/Florida border (Moler 1996, Pritchard 2006, Folt and Godwin 2013). The species has been protected as a nongame animal in Alabama since 1990 (Folt and Godwin 2013). Because relatively little is known regarding *Macrochelys* movements, and only 1 or 2 rivers for each *Macrochelys* species might provide a rescue effect, the BRG decided that the rescue effect is unknown for all 3 species and the initial findings should not change.

LISTING RECOMMENDATION

Staff reviewed the findings for the Suwannee alligator snapping turtle (*M. suwanniensis*) and agree that it met criterion D2 (population with a very restricted area of occupancy) and recommend listing the species as threatened based upon Version 8.1 of the IUCN Guidelines for Using the IUCN Red List Categories and Criteria, which is currently found at http://jr.iucnredlist.org/documents/RedListGuidelines.pdf. Staff concur with the finding of the Regional Assessment (following) that a rescue effect is unknown for the Suwannee alligator snapping turtle due to low population numbers north of Florida. In these situations, the listing guidelines recommend no change in the initial findings. The Apalachicola alligator snapping turtle (*M. apalachicolae*) does not meet any IUCN Red List criteria and staff recommends that this species should not be listed. The BRG found that the alligator snapping turtle (*M. temminckii*) met criterion B, with limited extent of occurrence and area of occupancy (B1,2), fewer than 10 locations (Ba) and projected decline in extent or quality of habitat (Bbiii). Staff reviewed these findings, and do not find enough evidence to support the projected decline due to sea level rise or degraded water quality in the next 90 years. Additionally, when reviewing the regional findings for a rescue effect, the Yellow, Perdido, and Escambia rivers all extend into Alabama, and alligator snapping turtles have been documented from all 3 rivers. Alligator snapping turtles are protected in Alabama, so no immediate threats are known that would limit the ability of these animals to move into Florida waters. Therefore, staff recommends not listing *M. temminckii*.

SUMMARY OF THE INDEPENDENT REVIEW

To be added after the peer review.

LITERATURE CITED

Allen, E. R., and W. T. Neill. 1950. The alligator snapping turtle *Macrochelys temminckii* in Florida. Ross Allen's Reptile Institute Special Publication 4:1−15.

Boundy, J., and C. Kennedy. 2006. Trapping survey results for the alligator snapping turtle (*Macrochelys temminckii*) in southeastern Louisiana, with comments on exploitation. Chelonian Conservation and Biology 5:3−9.

Dobie, J. L. 1971. Reproduction and growth in the alligator snapping turtle *Macroclemys temminckii* (Troost). Copeia 1971:645−658.

Echelle, A. A., J. C. Hackler, J. B. Lack, S. R. Ballard, J. Roman, S. F. Fox, D. M. Leslie, Jr., and R. A. Van Den Bussche. 2010. Conservation genetics of the alligator snapping turtle: cytonuclear evidence of range-wide bottleneck effects and unusually pronounced geographic structure. Conservation Genetics 11:1375−1387.

Elsey, R. M. 2006. Food habits of *Macrochelys temminckii* (alligator snapping turtle) from Arkansas and Louisiana. Southeastern Naturalist 5:443−452.

Enge, K. M., P. E. Moler, and T. M. Thomas. 2014a. Distributional survey of the alligator snapping turtle. Final Report, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Wildlife Research Laboratory, Gainesville, Florida, USA. 4pp.

Enge, K. M., T. M. Travis, and E. Suarez. 2014b. Population status, distribution, and movements of the alligator snapping turtle in the Suwannee River, Florida. Final Report, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Wildlife Research Laboratory, Gainesville, Florida, USA. 47pp.

Ernst, C. H., and J. E. Lovich. 2009. Turtles of the United States and Canada. Second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA. 827pp.

Ewert, M. A., and D. R. Jackson. 1994. Nesting ecology of the alligator snapping turtle (*Macroclemys temminckii*) along the lower Apalachicola River, Florida. Florida Game and Freshwater Fish Commission, Nongame Wildlife Program Report NC89-020, Tallahassee, Florida, 45pp.

Ewert, M. A., D. R. Jackson, and P. E. Moler. 2006. *Macrochelys temminckii* – alligator snapping turtle. Pages 58–71 *in* P. A. Meylan, editor. Biology and conservation of Florida turtles. Chelonian Research Monographs No. 3.

Florida Fish and Wildlife Conservation Commission (FWC). 2011. Alligator snapping turtle biological status review report. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA. 16pp.

Folt, B., and J. C. Godwin. 2013. Status of the alligator snapping turtle (*Macrochelys temminckii*) in South Alabama with comments on its distribution. Chelonian Conservation and Biology 12:211−217.

Folt, B., and C. Guyer. 2015. Evaluating recent taxonomic changes for alligator snapping turtles (Testudines: Chelydridae). Zootaxa 3947(3):447−450.

Harrel, J. B., and G. L. Stringer. 1997. Feeding habits of the alligator snapping turtle (*Macroclemys temminckii*) as indicated by teleostean otoliths. Herpetological Review 28:185–187.

Howey, C. A. F., and S. A. Dinkelacker. 2013. Characteristics of a historically harvested alligator snapping turtle (*Macrochelys temminckii*) population. Copeia 2013:58−63.

International Union for the Conservation of Nature (IUCN). 2010. Guidelines for using the IUCN Red List categories and criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee in March 2010. 85pp. Downloadable from http://jr.iucnredlist.org/documents/RedListGuidelines.pdf.

Jackson, D. R. 2002. Survey of an important distributional gap in the Florida range of the river cooter and other freshwater turtles. Florida Fish and Wildlife Conservation Commission Final Report, Tallahassee, Florida, USA. 27pp.

Jackson, D. R. 2005. Florida rivers and turtles: an interdependence. Pages 163–168 *in* W. E. Meshaka, Jr., and K. J. Babbitt, editors. Amphibians and reptiles: status and conservation in Florida. Kreiger Publishing Company, Malabar, Florida, USA.

Jensen, J. B., and W. S. Birkhead. 2003. Distribution and status of the alligator snapping turtle (*Macrochelys temminckii*) in Georgia. Southeastern Naturalist 2:25−34.

Johnston, G. R., T. M. Thomas, E. Suarez, A. Lau, and J. C. Mitchell. 2015. Population structure and body size of the Suwannee alligator snapping turtle (*Macrochelys suwanniensis*) in northern Florida. Chelonian Conservation and Biology 14:73−81.

King, R. L., and L. L. Smith. 2014. Status and distribution of the alligator snapping turtle (*Macrochelys temminckii*) in the Flint River in Georgia. Report to Georgia Department of Natural Resources. 17pp.

Lescher, T. C., J. T. Briggler, and Z. Tang-Martinez. 2013. Relative abundance, population structure, and conservation of alligator snapping turtles (*Macrochelys temminckii*) in Missouri between 1993−1994 and 2009. Chelonian Conservation and Biology 12:163−168.

Mays, J., T. Thomas, and K. Enge. 2015. Alligator snapping turtle survey. Final Report, Florida Fish and Wildlife Conservation Commission, Gainesville, Florida, USA. 22pp.

Moler, P. E. 1996. Alligator snapping turtle distribution and relative abundance. Florida Game and Freshwater Fish Commission, Final Report 7544. 13pp.

Pritchard, P. C. H. 2006. The alligator snapping turtle: biology and conservation. Second edition. Krieger Publishing Company, Malabar, Florida, USA. 140pp.

Reed, R. N., J. D. Congdon, and J. W. Gibbons. 2002. The alligator snapping turtle [*Macroclemys (Macrochelys) temminckii*]: a review of ecology, life history, and conservation, with demographic analyses of the sustainability of take from wild populations. Report to: Division of Scientific Authority, United States Fish and Wildlife Service. [available on the Internet at http://srelherp.uga.edu/projects/BobReedAlligatorSnapper-02.pdf].

Riedle, J. D., P. A. Shipman, S. F. Fox, J. C. Hackler, and D. M. Leslie, Jr. 2008. Population structure of the alligator snapping turtle, *Macrochelys temminckii*, on the western edge of its distribution. Chelonian Conservation and Biology 7:100–104.

Roman, J., S. D. Santhuff, P. E. Moler, and B. W. Bowen. 1999. Population structure and cryptic evolutionary units in the alligator snapping turtle. Conservation Biology 13:135–142.

Sloan, K. N., and J. E. Lovich. 1995. Exploitation of the alligator snapping turtle, *Macroclemys temminckii*, in Louisiana: a case study. Chelonian Conservation and Biology 1:221−222.

Sloan, K. N., K. A. Buhlmann, and J. E. Lovich. 1996. Stomach contents of commercially harvested adult alligator snapping turtles, *Macroclemys temminckii*. Chelonian Conservation and Biology 2:96−99.

Snider, A. T., and J. K. Bowler. 1992. Longevity of reptiles and amphibians in North American collections. Second edition. Society for the Study of Amphibians and Reptiles Herpetological Circular 21:1−40.

Spindel, E. L., J. L. Dobie, and D. F Buxton. 1987. Functional mechanisms and histologic composition of the lingual appendage in the alligator snapping turtle, *Macroclemys temminckii* (Troost) (Testudines: Chelydridae). Journal of Morphology 194:287−301.

Thomas, T. M., M. C. Granatosky, Jason R. Bourque, K. L. Krysko, P. E. Moler, T. Gamble, E. Suarez, E. Leone, K. M. Enge, and J. Roman. 2014. Taxonomic assessment of alligator snapping turtles (Chelydridae: *Macrochelys*), with the description of two new species from the southeastern United States. Zootaxa 3768(2):141–165.

Tucker, A. D., and K. N. Sloan. 1997. Growth and reproductive estimates from alligator snapping turtles, *Macroclemys temminckii*, taken by commercial harvest in Louisiana. Chelonian Conservation and Biology 2: 587−592.

Biological Status Review Information
Findings

Species/taxon: Suwannee Alligator Snapping Turtle
Date:
Assessors: Kevin Enge, Dale Jackson, Peter Meylan, Paul Moler, and Travis Thomas
Generation length: 30-40 years (ca. 35 years)

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Limited harvest has occurred throughout the past 90 years, but commercial harvest was minimal or nonexistent, and recent sampling data suggest that a 50% decline is unlikely.	I	N	Enge et al. 2014b
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	Insufficient data to make determination of 30% decline.	I	N	Enge et al. 2014b
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and reduction of the population, but unlikely that the reduction would be at least 30%.	I	N	
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	We suspect that there has not been a 30% decline although there was some historic harvest and current incidental harvest plus the potential for additional decline due to projected sea level rise.	I	N	
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				

(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	15,581 km^2	E	Y	A GIS analysis could be conducted, but the approximate range encompasses 11 counties that have a total area of 15,581 km^2
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	< 2,000 km^2	E	Y	The area of rivers inhabited is < 2,000 km^2
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	a. Severely fragmented or exist in ≤ 10 locations	Occurs in 4 locations: Suwannee River and 3 major tributaries, the New, Santa Fe, and Withlacoochee rivers. Trapping has failed to find turtles in 7 rivers in the Big Bend region between the Suwannee and Ochlockonee rivers. The most plausible threat is a toxic chemical spill at a highway/railroad crossing or in a city near the headwaters that would rapidly affect all downstream turtles. The Ichetucknee R., a springfed tributary of the Santa Fe R., is not included as a location because a paved road crossing is lacking near its headwaters.	Y	Enge et al. 2014a, Thomas et al. 2014, Johnston et al. 2015
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and a corresponding decline. Future water quality decline and increased human demand for the water could also result in decline of the population.	I/S	Y	
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers relatively stable.	O	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	The population size in the Suwannee R. downstream of White Springs is estimated at ≈1,000 adult turtles, and the population size in the entire drainage is far less than 10,000 turtles	E	Y	Enge et al. 2014b, Johnston et al. 2015
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations,	Defer to Cc2.			

whichever is longer (up to a maximum of 100 years in the future) OR				
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	With strong enforcement of 2009 FWC rules prohibiting take, population is likely to grow.	P	N	
a. Population structure in the form of EITHER	The Suwannee/lower Santa Fe/Withlacoochee River/ subpopulation has > 1000 adults.	E	N	Enge et al. 2014b, Johnston et al. 2015
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No; occurs in 2 subpopulations. One subpopulation is upstream of the land bridge in the Santa Fe R.; limited terrestrial mobility limits gene exchange between these subpopulations, except during floods.	O	N	Johnston et al. 2015
b. Extreme fluctuations in number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers provide relatively stable habitat.	O	N	Jackson 2005, Ewert et al. 2006
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	The Suwannee R. downstream of White Springs contains an estimated 1,000 adult turtles; the population is > 1,000 when the Santa Fe R. and other tributaries are included.	E	N	Enge et al. 2014b
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	Estimated area of occupancy exceeds this, but the number of locations is only 4 (Suwannee, New, Santa Fe, and Withlacoochee rivers).	S	Y	Thomas et al. 2014
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	Uncertain; Reed et al. (2002) model assumptions questionable, but suggests possible with even moderate take.	P	N	Reed et al. 2002

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	B1,2ab(iii), D2

Is species/taxon endemic to Florida? (Y/N)	N
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	B1,2ab(iii), D2

Regional Assessment

1	Biological Status Review Information Regional Assessment	Species/taxon: Suwannee Alligator Snapping Turtle
2		Date:
3		Assessors: Kevin Enge, Dale Jackson, Peter Meylan,
4		Paul Moler, and Travis Thomas
5		
6		
7		
8	Initial finding	
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	N
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	Do not know
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the regional population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	Threatened

Biological Status Review Information
Findings

Species/taxon: Apalachicola Alligator Snapping Turtle
Date:
Assessors: Kevin Enge, Dale Jackson, Peter Meylan, Paul Moler, and Travis Thomas
Generation length: 30-40 years (ca. 35 years)

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Limited harvest has occurred throughout the past 90 years, but commercial harvest was apparently restricted, and recent sampling data suggest it is unlikely that there has been a 50% decline.	I	N	Moler 1996; Ewert et al. 2006; Pritchard 2006; Thomas, unpubl. data
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	Insufficient data to make determination of 30% decline.	I	N	Ewert et al. 2006, Pritchard 2006
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and reduction of the population, but group is uncertain that the reduction would be at least 30%.	I	N	
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	We suspect a that there has not been a 30% decline although there was historic and continuing harvest and potential for additional decline due to projected sea level rise.	I	N	Ewert et al. 2006, Pritchard 2006
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	13,714 km^2	E	Y	Area of Holmes and half of Walton Co. east to Leon/Wakulla counties
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	< 2,000 km^2	E	Y	
AND at least 2 of the following:				

a. Severely fragmented or exist in ≤ 10 locations	Occurs in at least 13 locations: Apalachicola R., Ochlockonee R., Choctawhatchee R., Sopchoppy R., Telogia Cr., New R., Chipola R., Juniper Cr., Wetappo Cr., Sandy Cr., Econfina Cr., Holmes Cr., and Turkey Cr.	O	N	Ewert et al. 2006, FL Natural Areas Inventory (FNAI)
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and a corresponding decline. Future water quality decline and increased human demand for the water could also result in decline of the population.	I/S	Y	
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers relatively stable.	O	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Population size likely < 10,000 adults	S	Y	Moler 1996, Ewert et al. 2006 offer catch-per-unit-effort data, but no population numbers.
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Defer to Cc2.			
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	With strong enforcement of 2009 FWC rules prohibiting take, population likely to grow.	P	N	
a. Population structure in the form of EITHER	No suitable quantitative population size data but likely > 1000 in the Apalachicola drainage subpopulation.	S	N	Ewert et al. 2006
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No; occurs in several independent drainages.	O	N	Ewert et al. 2006
b. Extreme fluctuations in number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers provide relatively stable habitat.	O	N	Jackson 2005, Ewert et al. 2006
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Few quantitative data available, but trapping surveys on several rivers and a nesting study on the Apalachicola River suggest > 1,000 adults.	S	N	Ewert and Jackson 1994; Moler 1996; FWC, unpubl. data
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	Both estimated area of occupancy (440 km2) and number of inhabited rivers (1@; each river is at least one location) exceed this.	S	N	Ewert et al. 2006

(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	Uncertain; Reed et al. (2002) model assumptions questionable, but suggests possible with even moderate take.	P	N	Reed et al. 2002

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Not Threatened	None
Is species/taxon endemic to Florida? (Y/N)	N
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Not Threatened	None

Regional Assessment

1	Biological Status Review Information Regional Assessment	Species/taxon: Apalachicola Alligator Snapping Turtle
2		Date:
3		Assessors: Kevin Enge, Dale Jackson, Peter Meylan,
4		Paul Moler, and Travis Thomas
5		
6		
7		
8	Initial finding	
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	N
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	Do not know
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the regional population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	Not Threatened

Biological Status Review Information
Findings

Species/taxon: Alligator Snapping Turtle (*M. temminckii*)
Date:
Assessors: Kevin Enge, Dale Jackson, Peter Meylan, Paul Moler, and Travis Thomas
Generation length: 30-40 years (ca. 35 years)

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Has been harvest throughout the past 90 years however due to historic harvest pressures and existing sampling data it is unlikely that there has been a 50% decline.	I	N	Pritchard 2006
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	Insufficient data to make determination of 30% decline.	I	N	Pritchard 2006
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and reduction of the population, but group is uncertain that the reduction would be at least 30%.	I	N	
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	We suspect a that there has not been a 30% decline although there was historic and continuing harvest and potential for additional decline due to projected sea level rise.	I	N	Pritchard 2006
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	8,145 km^2	E	Y	Area of Escambia, Santa Rosa, Okaloosa, and half of Walton Co.
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	> 2,000 km^2	E	Y	
AND at least 2 of the following:				

a. Severely fragmented or exist in ≤ 10 locations	Occurs in 8 locations: Blackwater R., East Bay R., Escambia R., Perdido R., Pond Cr., Yellow R., Coldwater Cr., and Shoal R.	O	Y	
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Projections for sea level rise during the next 90 years may increase the salinity of the waterways which could result in habitat loss and a corresponding decline. Future water quality decline and increased human demand for the water could also result in decline of the population.	I/S	Y	
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers relatively stable.	O	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Population size likely < 10,000 adults	S	Y	Moler 1996
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Defer to Cc2.			
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	With strong enforcement of 2009 FWC rules prohibiting take, population likely to grow.	P	N	
a. Population structure in the form of EITHER	No suitable quantitative population size data but likely no subpopulation contains > 1000 adults based upon the much longer Suwannee River containing ≈1,000 adults.	S	Y	Moler 1996, Enge et al. 2014b
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	No; occurs in several independent drainages.	O	N	
b. Extreme fluctuations in number of mature individuals	No; extreme fluctuations unlikely in long-lived species; rivers provide relatively stable habitat.	O	N	Jackson 2005
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Few quantitative data available, but a trapping survey of several rivers suggest > 1,000 sdults.	S	N	Moler 1996
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	Both estimated area of occupancy (8,145 km^2) and number of locations (8) exceed this.	S	N	
(E) Quantitative Analyses				

e1. Showing the probability of extinction in the wild is at least 10% within 100 years	Uncertain; Reed et al. (2002) model assumptions questionable, but suggests possible with even moderate take.	P	N	Reed et al. 2002

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	B1,2ab(iii)
Is species/taxon endemic to Florida? (Y/N)	N
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	B1,2ab(iii)

Regional Assessment

1	Biological Status Review Information Regional Assessment	Species/taxon: Alligator Snapping Turtle
2		Date:
3		Assessors: Kevin Enge, Dale Jackson, Peter Meylan,
4		Paul Moler, and Travis Thomas
5		
6		
7		
8	Initial finding	
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	N
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	Do not know
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the regional population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	Threatened

Appendix 1. Calculation of generation time presented at the BSR group meeting

Generation length is defined as the average age of parents of the current cohort, which is greater than the age at first breeding and less than the age of the oldest breeding individual. We estimate generation length for the alligator snapping turtle as follows. Dobie (1971) estimated both sexes mature in Louisiana in 11−13 years (no data for Florida) but noted a two-thirds decline in growth rate by ages 16−35; this suggests slightly later maturation, probably closer to 15−20. Lifespan in the wild is unknown (Ewert et al. 2006), but individuals may live > 75 years in captivity (Snider and Bowler, 1992). We therefore conservatively estimate average age of parents at 30−40 years and recognize that this is more likely to be an underestimate than overestimate. Reed et al. (2002) estimated a generation length of 49 years.

Appendix 2. Biological Review Group Members Biographies

Kevin M. Enge received his M.S. in Wildlife Ecology and Conservation from the University of Florida and B.S. degrees in Wildlife and Biology from the University of Wisconsin–Stevens Point. He is currently an Associate Research Scientist in the Reptile and Amphibian Subsection of the Wildlife Research Section, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission (FWC). He has worked for FWC since 1989, serving as a nongame survey and monitoring biologist and the Herp Taxa Coordinator. He has conducted numerous surveys of both native and exotic amphibians and reptiles, and he has > 100 scientific papers and 45 reports.

Dr. Dale R. Jackson received his Ph.D. degree in Zoology from the University of Florida and his B.S. degree in Zoology from Eastern Illinois University. He serves as Senior Research Zoologist of the Florida Natural Areas Inventory (FNAI), which he helped found in 1981. At FNAI, he oversees database development for rare amphibians, reptiles, and aquatic invertebrates and is a principal advisor to the Florida Forever land acquisition program. Since moving southward from Illinois to pursue graduate studies, he has spent 44 years studying and conserving Florida's herpetofauna, with research emphasis on freshwater turtles, and has published more than 70 scientific papers and book chapters.

Dr. Peter A. Meylan received his Ph.D. from the University of Florida. He is currently R.R. Hallin Professor of Natural Sciences at Eckerd College in Saint Petersburg, FL. His research interests include the evolutionary history, ecology, and conservation biology of amphibians and reptiles, especially turtles. Current research includes two sea turtle projects: an investigation of the ecology and migrations of sea turtles of Bocas del Toro Province, Panama (funded by the Wildlife Conservation Society) and the Bermuda Turtle Project, which is a cooperative project with the Bermuda Aquarium and the Sea Turtle Conservancy. He studies the biology of freshwater turtles in Florida with the Eckerd Herpetology Club mostly on the Rainbow River in Marion County. He has published nearly 100 scientific articles on turtles and is the editor of a book on the biology and conservation of all Florida turtles that was published in 2006.

Paul E. Moler received his M.S. in Zoology from the University of Florida in 1970 and his B.A. in Biology from Emory University in 1967. He retired in 2006 after working for 29 years as a herpetologist with FWC, including serving as administrator of the Reptile and Amphibian Subsection of the Wildlife Research Section. He has conducted research on the systematics, ecology, reproduction, genetics, and conservation biology of a variety of herpetofaunal species in Florida, with primary emphasis on the biology and management of endangered and threatened species. He served as Chair for the Florida Committee on Rare and Endangered Plants and Animals in 1992–94, Chair of the Committee on Amphibians and Reptiles since 1986, and editor of the 1992 volume on amphibians and reptiles. Paul has > 90 publications on amphibians and reptiles.

Travis M. Thomas received his M.S. in Wildlife Ecology and Conservation and Bachelor's Degree in Natural Resources Conservation from the University of Florida. Travis was hired by FWC in 2008, and he has worked on numerous projects concerning reptile and amphibian ecology. Travis now works for the Nature Coast Biological Station. He has published several

notes on the ecology and distribution of reptiles and has published on the taxonomy of *Macrochelys* and on the population ecology of *M. suwanniensis* in the Suwannee and Santa Fe rivers.