

COSSARO Candidate Species at Risk Evaluation
for
Blue Racer (*Coluber constrictor foxii*)

Committee on the Status of Species at Risk in Ontario (COSSARO)

Assessed by COSSARO as Endangered

May 2012

Final

La **Couleuvre agile bleue** (*Coluber constrictor foxii*) est l'un des serpents les plus imposants de l'Ontario. Constricteur se déplaçant rapidement, elle est sans danger pour les humains. En Ontario, la Couleuvre agile bleue était présente en faible quantité sur la terre ferme près des rives des lacs Huron, St. Clair et Érié, et sur l'île Pelée dans l'extrême sud-ouest de la province. Toutes les populations sur la terre ferme sont maintenant disparues et il ne subsiste qu'une petite population (moins de 250 individus matures) sur l'île Pelée. Sur l'île, on trouve la Couleuvre agile bleue dans Chinquapen Oak - Nodding Onion Treed Alvar Grassland, une communauté végétale rare à l'échelle provinciale (S1), dans la savane, les terres épuisées et les autres types d'habitat ouvert et semi-ouvert. La Couleuvre agile bleue est menacée sur l'île Pelée en raison de certaines menaces anthropogéniques. Une menace importante est la mortalité sur les routes, une menace qui croît à mesure qu'augmente la circulation automobile saisonnière. Bien que l'île Pelée soit encore un milieu largement rural, les pressions de développement se maintiennent et menacent de réduire encore davantage la quantité et la qualité de l'habitat disponible pour la Couleuvre agile bleue, bien que de récents achats de terrains visant à préserver l'habitat puissent réduire le déclin. La Couleuvre agile bleue est classée dans les espèces **en voie de disparition** selon les critères du CDSEPO et du COSEPAC.

Cette publication hautement spécialisée, COSSARO Evaluation for Blue Racer n'est disponible qu'en anglais en vertu du Règlement 671/92 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez contacter le secrétariat de COSSARO par courrier électronique à l'adresse COSSAROsecretariat@ontario.ca.

PART 1- Current status and distribution

Current designations:

GRANK – G5 The subspecies *Coluber constrictor foxii* occurring in Ontario is ranked G5T5 (NatureServe 2011) (Assessed 09/05/2009) (NatureServe, accessed 13/05/2012)

NRANK Canada – N1 (Assessed 20/09/2012) (NatureServe, accessed 13/05/2012)
COSEWIC – Endangered (COSEWIC, 2012)

SARA – Endangered (Schedule 1) (Environment Canada, 2012)

ESA 2007 – Endangered (Ministry of Natural Resources, 2007)

SRANK – S1 (NHIC/NatureServe, accessed 13/05/2012)

Distribution in Ontario:

Coluber constrictor foxii currently occurs only on Pelee Island (4091 ha) in Ontario. Although formerly present in Point Pelee National Park and Pinery Provincial Park in extreme southwestern Ontario, the Blue Racer is almost certainly extirpated from all mainland sites, despite these being protected areas. The last reliable record of the Blue Racer in mainland Ontario was 1983 (Campbell & Perrin 1991). On Pelee Island, the species is restricted to the eastern two thirds of the island.

Distribution and status outside Ontario:

Coluber constrictor, the Racer, is widespread throughout North America from Maine to British Columbia and south to Florida and northern Guatemala (Campbell and Perrin 1991; Harding 1997). NatureServe (2012) suggests the species is common (G5) in the United States. *Coluber constrictor foxii* (Blue Racer), the subspecies that occurs in Ontario, was historically distributed from southeastern Minnesota and Iowa east to Ohio and north to extreme southwestern Ontario. Outside Ontario, extant populations of the Blue Racer are presently found in Ohio Indiana, Illinois, Michigan, Wisconsin and Iowa (Harding 1997; COSEWIC 2002, 2012).

PART 2- Eligibility for Ontario status assessment

2.1 Application of eligibility criteria

Taxonomic distinctness

Yes. *Coluber constrictor* is a polytypic species with 11 subspecies recognized (NatureServe 2012). There is still controversy surrounding the taxonomy and geographic distribution of several of these subspecies. Depending on the source consulted two or three subspecies are recognized in Canada. *C. c. mormon* (Western Yellow-bellied Racer) occurs west of the Rocky Mountains in British Columbia. The Eastern Yellow-bellied Racer, (*C. c. flaviventris*) is found in extreme southern Saskatchewan and is also listed by some authors as being present in southern Ontario (NatureServe 2012). Today, many authors accept that the valid Racer subspecies found in Ontario is the Blue Racer (*C. c. foxii*) (Campbell and Perrin 1991; Harding 1997; Mackinnon and Porchuk 2006). Burbrink et al. (2008) studied the phylogeography of *Coluber constrictor* using the mtDNA cytochrome b gene, and mapped Ontario racers as belonging to a central clade which has a much larger range than is traditionally attributed to subspecies *foxii*. However, no Ontario snakes were actually sampled for this study. Burbrink et al. (2008) proposed no taxonomic changes, but suggested that *C. constrictor* may not be a single taxon, particularly because several lineages are well defined geographically and are of ancient origin. At this time, there is no agreed upon new name for the Blue Racer. In any case, putative changes in nomenclature will have no assessment significance for Ontario racers as they are clearly a single DU. The subspecific status of the snake in Canada remains unchanged as *Coluber constrictor foxii* (Crother et al. 2008).

Designatable units

All Ontario Blue Racers live on Pelee Island and they do not meet any of the COSSARO/COSEWIC criteria for having more than one DU.

Native status

Yes. The Blue Racer is a well established valid, native taxon in Ontario.

Presence/absence

Present. Blue Racers exist on Pelee Island.

2.2 Eligibility results

1. The putative taxon or DU is valid. Yes
2. The taxon or DU is native to Ontario. Yes
3. The taxon or DU is present in Ontario. Present

PART 3- Ontario status based on COSSARO evaluation criteria

3.1 Application of primary criteria (rarity and declines)

1. Global Rank
Not in any category. G5
2. Global Decline
Not in any category. No major range wide declines have been reported.
3. Northeastern North America Ranks
Threatened. Although *C. c. foxii* was reported from seven northeastern North American jurisdictions (Ontario, Minnesota, Indiana, Illinois, Michigan, Wisconsin and Iowa) in COSEWIC 2002, NatureServe (2012) currently only lists the subspecies *C. c. foxii* as being present in two northeastern North American jurisdictions: Ontario and Indiana (NatureServe 2012; COSEWIC 2002, 2012). Applying the above rank selection criteria to *C. c. foxii* which is ranked S1, S2, SH or SX in one of the two (50%) northeastern North American jurisdictions in which it occurs, this subspecies would qualify as Threatened under this criterion. (Some authors consider *C. c. foxii* a synonym of the subspecies *C.c. flaviventris*, but Ontario is the only northeastern jurisdiction listed in *C.c. flaviventris* distribution (NatureServe 2012). At the species level, *Coluber constrictor* is Not in Any Category. It is ranked S1, S2, SH, or SX in 4 (Maine S2, Vermont S1, Wisconsin S2, Ontario S1) of the 19 (22%) of the northeastern North American jurisdictions in which it occurs and is ranked. It is ranked S3 in one jurisdiction (NatureServe 2012).
4. Northeastern North America Decline
Not in any category. *Coluber constrictor* is reported to have declined in several North American jurisdictions, but the extent of the decline has not been quantified. Remaining populations are extensive and not threatened in most areas.
5. Ontario Occurrences
Endangered. There are three recently verified element occurrences (EO's) in Ontario that are all located close to one another on Pelee Island (Porchuk 1996; Willson 2000; COSEWIC 2002, 2012; Natural Heritage Information Centre (NHIC) database 2002; MacKinnon and Porchuk 2006). Designation of three EO is based on Porchuk's (1996) identification of three discrete Blue Racer hibernation complexes, and the snakes exhibit high site fidelity to these hibernacula. If Porchuk's population distinctions were disregarded and the

NatureServe (2012) EO specifications for this taxon were strictly applied, there would only be one extant occurrence in the province (Hammerson 2001). Based on two series of 3-year capture mark-recapture studies (from 1993–1995 and 2000–2002 respectively), it is estimated that the adult population is less than 250 adults (Willson 2002, MacKinnon and Porchuk 2006; COSEWIC 2012). NHIC (2012) recognizes one extant, one historical, and three extirpated occurrences.

6. Ontario Decline

Endangered. Ontario is at the northern edge of the Blue Racer's range. Although now restricted to Pelee Island, this species formerly had a limited distribution in southwestern Ontario in Essex, Kent and Lambton Counties. Populations known from Point Pelee National Park, Camp Ipperwash, Pinery Provincial Park and the Wheatley area have not been recorded in at least 20 years and are now considered extirpated. Loss of these populations represents at least a 60 percent reduction in the number of extant element occurrences in the province (Natural Heritage Information Centre Database 2002). There are few historical data on the size of the Ontario population, therefore it is difficult to estimate the degree to which the population has declined. Nevertheless, based on the considerable contraction in this species' distribution in the province since historical times, it is probable that at least a 75% population decline has occurred. Porchuk (1996) observed a 33% decline in the Pelee Island population between 1993 and 1995, however it is unclear whether his statistics represented a true decline or were an artifact of the statistical approach used (MacKinnon and Porchuk 2006). Willson (2002) suggested further decline, but the two surveys used different methods and so were not directly comparable (MacKinnon and Porchuk 2006).

Although no formal surveys have been conducted since 2002 (Willson pers. comm. 2011; Woodliffe pers. comm. 2011), there is some reason to be concerned that changes in population structure and size and increased fragmentation of populations and habitat have occurred on Pelee Island (MacKinnon and Porchuk 2006; Willson pers. comm. 2011; Woodliffe pers. comm. 2011). Increasing road traffic, introduction of Wild Turkeys (*Meleagris gallopavo*), which depredate snakes, increased development and, possibly, persecution by humans since the last assessment, suggest the possibility that the number of mature individuals has declined. There have been 11 'informal' annual surveys from 2000 to 2009 organized by Scales Nature Park/Sciensational Ssnakes!! staff that suggest further that numbers may have declined since the 2002 COSEWIC report. During these surveys, only very small numbers of racers were found at previously known sites, and three additional searches in 2010 (1) and 2011 (2) resulted in no observations. No racers have

been located at the Stone Road Alvar site since 2001 (J. Hathaway pers. comm. 2011).

7. Ontario's Conservation Responsibility

Not in any category. Ontario has less than 10% of the global range of this species, although if we consider only *C. c. foxii*, then it would be more, but still likely Not in any category.

3.2 Application of secondary criteria (threats and vulnerability)

8. Population Sustainability

Endangered. There is no evidence of complete recruitment failure in the Ontario population as neonates and yearlings have been observed in recent years. Population viability studies have not been conducted for the Ontario population, and the minimum viable population size for Pelee Island Blue Racers is not known, although it is likely to be at least an order of magnitude greater than the estimated population size of fewer than 250 (Reed et al. 2003; Traill et al. 2007). Small, isolated populations such as racers on Pelee Island are vulnerable to extinction due to demographic stochasticity, catastrophic events and loss of genetic variability (MacKinnon and Porchuk 2006). Added to this major constraint are several other threats including mortality on roads, habitat degradation, and increasing fragmentation of habitat and the species' populations (COSEWIC 2012).

9. Lack of Regulatory Protection for Exploited Wild Populations

Not in any category. Blue Racer is protected as an endangered species under both the federal *Species at Risk Act* (2002), and Ontario's *Endangered Species Act, 2007*. In addition, it is listed as a "Specially Protected Reptile" under Schedule 9 of the Ontario *Fish and Wildlife Act* which makes it illegal to harass, possess (without a permit), or kill this specie The Blue Racer is not exploited in Ontario. On Pelee Island, two important areas of Blue Racer habitat have some degree of protection. Land at Lighthouse Point is under a combination of private, provincial government and conservation authority ownership. The Stone Road Alvar site is owned and managed by Ontario Nature, Essex Region Conservation Authority and Nature Conservancy Canada (although no racers have been seen there in a decade). A recovery team has been established for the Blue Racer in Ontario and a recovery plan has been prepared by MacKinnon and Porchuk 2006; COSEWIC 2012). Since 1999, the Nature Conservancy of Canada (NCC) has purchased properties on Pelee Island, totalling over 400 ha. These sites include areas where Blue Racers are known to persist, adjacent habitat, and areas on the west side of the island that may provide future habitat. The protection offered by these recent purchases could be key to maintenance of the species in Canada, especially when combined with habitat already protected on the island (MacKinnon and Porchuk 2006; McFarlane pers. comm. 2011;

Porchuk pers. comm. 2011; Willson pers. comm. 2011; Woodliffe pers. comm; COAEWIC 2012). A brief summary of recent purchases by NCC follows (as quoted from correspondence with Mhairi McFarlane, pers. comm. 2011):

1. Florian Diamante Nature Reserve (FDNR) 5 ha, acquired 2007.
2. Middle Point Woods acquired 2010, 10 ha
3. Stone Road Alvar 4 ha + 1999, 2006, 2010.
4. Richard and Beryl Ivey property 51 ha, 2006, 2008.

10. Direct Threats

Endangered. The Blue Racer population on Pelee Island faces a number of direct anthropogenic threats. Each year a significant number of Blue Racers are killed on Pelee Island roads. For example, from 1993 to 1995 a minimum of 75 Blue Racers were killed by motor vehicles (Porchuk 1996). Mortality of snakes on roads has declined in recent years despite the addition of increased capacity ferry service in 1992 (Porchuk and Brooks 1995), and road improvements in 1994 that contributed to a significant increase in the volume and velocity of traffic on island roadways. These observations support other more direct evidence that the overall population size is decreasing. Compounding the problem is the separation of hibernacula and foraging habitat from one of the principal Blue Racer oviposition sites by a main island roadway. Consequently, adult female and hatchling Blue Racers are killed travelling across this stretch of road (MacKinnon and Porchuk 2006).

Development on Pelee Island has steadily increased in recent years resulting in reduction of available habitat. Of particular significance is the loss of areas of critical shoreline Blue Racer oviposition habitat (Porchuk and Brooks 1996) due to cottage development. In addition, removal and disturbance of logs and wood debris due to increased human activity along shorelines, reduces the quantity of already limited oviposition habitat available. Because it is a large snake, the Blue Racer is also subject to persecution because of human fear and dislike of snakes. Snakes and artificially constructed hibernacula have been deliberately destroyed by some individuals due to the conflict between land development and preservation of snake habitat (Jaimet 2001; COSEWIC 2001).

11. Specialized Life History or Habitat–use Characteristics

Endangered. Blue Racer can be found in a variety of open habitats (e.g., prairies, savannas, old fields, shrub thickets and hedgerows). On Pelee Island the Blue Racer spends about 80% of its active time in open and semi–open habitat, therefore vegetation succession is detrimental to racers. Although this species requires fairly open habitat, it does not adapt well to cultural open areas that are subject to human disturbance (e.g., cottage sites, vineyards, intensive

agriculture). Blue Racer populations on Pelee Island occur in several habitat types that are rare in the province including: Chinquapin Oak – Nodding Onion Treed Alvar Grassland Type (S1) and Dry–Fresh Hackberry Deciduous Forest Type (S2) province (Bakowsky 1996).

3.3 COSSARO evaluation results

1. Criteria satisfied in each status category

Number of primary and secondary criteria met in each status category:

Endangered – [2/3]
Threatened – [1/0]
Special concern– [0/0]

Number of Ontario–specific criteria met in each status category:

Endangered – [2]
Threatened – [0]
Special concern – [0]

2. Data deficiency

No.

3. Status Based on COSSARO Evaluation Criteria

The application of COSSARO evaluation criteria suggests that the Blue Racer is Endangered in Ontario.

PART 4- Ontario status based on COSEWIC evaluation criteria

4.1 Application of COSEWIC criteria

Regional (Ontario) COSEWIC criteria assessment

Criterion A – Decline in total number of mature individuals

Not applicable. There is no evidence to demonstrate that declines exceed 30% over the past three generations.

Criterion B – Small distribution range and decline or fluctuation

Endangered. Meets Endangered B1 and B2 as EO and IAO are well below thresholds and meets subcriteria ab (iii,v) as it is found in a single location, there is a decline in extent and quality of habitat with succession and projected development for recreation, and there is a continuing decline in the number of mature individuals.

Criterion C – Small and declining number of mature individuals

Endangered. Meets Endangered C2 as there is a continuing decline in numbers of mature individuals; meets C2a(i) as no population is estimated to contain >250 mature individuals, and meets C2a(ii) as one population has >95% of all mature individuals.

Criterion D – Very small or restricted total population

Endangered. Meets Endangered D1 as population is estimated to have < 250 adults.

Criterion E – Quantitative analysis

Insufficient information.

Rescue effect

No. Generally the species is secure throughout its US range and it has a global status of G5 (NatureServe 2012). *Coluber c. foxii* is only ranked in Indiana (where it is S4). This subspecies likely occurs in other jurisdictions, but taxonomic confusion make it difficult to determine the subspecies' global distribution. At the species level, *C. constrictor* is ranked S4 or S5 in Michigan, Ohio, New York, and Pennsylvania where the *foxii* subspecies is likely to occur. *Coluber c. foxii* is ranked G5T5 and *C. constrictor* is G5 (NatureServe, 2012). It is unlikely that snakes will reach Pelee Island or invade mainland southwestern Ontario because of the Great Lakes barrier and the intensive development along much of the relevant Great Lakes' shoreline.

Special concern status

No.

4.2 COSEWIC evaluation results

1. Criteria satisfied in each status category

- Endangered – [yes]
- Threatened – [NA]
- Special concern – [NA]

2. Data Deficiency

No.

3. Status based on COSEWIC evaluation criteria

The application of COSEWIC evaluation criteria suggests that the Blue Racer is Endangered in Ontario.

PART 5- Ontario status determination

5.1 Application of COSSARO and COSEWIC criteria

COSSARO and COSEWIC criteria give the same result. Yes

5.2 Summary of status evaluation

Blue Racer is classified as Endangered in Ontario.

The Blue Racer (*Coluber constrictor foxii*) is one of Ontario's largest snakes. A fast-moving constrictor, it is harmless to humans. In Ontario, the Blue Racer formerly had a restricted distribution on the mainland in areas near the shores of lakes Huron, St. Clair and Erie and on Pelee Island in extreme southwestern Ontario. All mainland populations in Ontario are now extirpated and only a small population (<250 mature individuals) remains on Pelee Island. On Pelee Island, the Blue Racer occurs in: Chinquapin Oak – Nodding Onion Treed Alvar Grassland a provincial rare community type (S1), savanna, old fields and other types of open and semi-open habitat. The Blue Racer is at risk on Pelee Island due to a number of anthropogenic threats. A major threat is road mortality and this threat is increasing as the volume of seasonal traffic continues to rise. Although Pelee Island is still largely rural, pressures from development are ongoing and threaten to reduce further the quantity and quality of Blue Racer habitat available, although recent purchases of land parcels to maintain habitat may alleviate this decline. Blue Racer is designated Endangered under both COSSARO and COSEWIC criteria.

Information sources

1. Literature cited

- Bakowsky, W.D. 1996. Natural Heritage Resources of Ontario: Vegetation Communities of Southern Ontario. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, ON. 21 pp.
- Burbrink, F.T., Fontanella, R.A., Pyron, T. J., Guider, and C. Jimenez 2008. Phylogeography across a continent: The evolutionary and demographic history of the North American racer (Serpentes: Colubridae: *Coluber constrictor*). *Molecular Phylogenetics and Evolution*: 47: 274–288.
- Campbell, C.A., and D.W. Perrin. 1991. Status of the blue racer snake (*Coluber constrictor foxii*) in Canada. Status Report. COSEWIC. [With additions on the eastern and western yellowbelly racers by J.M. Macartney and additions on the blue racer by B.D. Porchuk; revised and edited by I. Bowman, and the Subcommittee on Amphibians and Reptiles of COSEWIC for the 1991 meeting; and by R.J. Brooks in 1997], 42 pp.
- COSEWIC. 2002. COSEWIC assessment and update status report the blue racer *Coluber constrictor foxii*. Committee on the Status of Endangered Wildlife in Canada in Canada. Ottawa. vi + 17 pp.
- COSEWIC. 2012. COSEWIC Status Assessment Summary update status report on the blue racer *Coluber constrictor foxii*. Committee on the Status of Endangered Wildlife in Canada in Canada. Ottawa. vi + 15 pp.
- Crother, B.I., J. Boundy, F.T. Burbrink, J.A. Campbell, and R.A. Pyron. 2008. Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico. Edition 6.1. [Society for the Study of Amphibians and Reptiles](#). No. 37 pp. 1–84. [Web site accessed August 1 2011].
- Hammerson, G. 2001. EO Specs for Medium and Large Colubrid Snakes (ELCODE ARADB00002). NatureServe, unpublished. 2 pp.
- Harding, J.H. 1997. Amphibians and Reptiles of the Great Lakes Basin. University of Michigan Press, Ann Arbor. 378 pp.
- Hathaway, J. 2011. Email correspondence to S. Gillingwater. August 2011. Director Scienstational Sssnakes!!
- Jaimet, K. 2001. Islanders spitting venom: snake campaign a lesson in failure. Windsor Star, Saturday September 1, 2001.

- MacKinnon, C.A., and B.D. Porchuk. 2006. Recovery Strategy for the Blue Racer (*Coluber constrictor foxii*) in Canada (Draft). Blue Racer Recovery Team.
- McFarlane, Mhairi, pers. comm. 2011. Email correspondence to S.Gillingwater. August 2011. Conservation Biologist, The Nature Conservancy of Canada, London, ON
- Natural Heritage Information Centre. 2002. Biological and Conservation Database (BCD) and manual files. Peterborough, ON
- NatureServe. 2012. [NatureServe web site](#). Last reviewed August 2006. [Accessed May 15, 2012].
- Porchuk, B. 1996. Ecology and conservation of the endangered blue racer snake (*Coluber constrictor foxii*) on Pelee Island, Canada. M.Sc. Thesis, University of Guelph. 162 pp.
- Porchuk, Ben, pers. comm. 2011. Email correspondence to S. Gillingwater. August 2011. Blue Racer Recovery Team, Ecologist, London, ON
- Porchuk, B.D. and R.J. Brooks. 1995. Conservation and biology of the endangered Blue Racer snake (*Coluber constrictor foxii*) on Pelee Island. Progress Report II, March 14. Department of Zoology, Guelph University.
- Porchuk, B.D., and R.J. Brooks. 1996. Natural History: *Coluber constrictor*, *Elaphe vulpina* and *Chelydra serpentina*. Reproduction. Herpetological Review 26: 148.
- Reed, D.H., J.J. O'Grady, B.W. Brook, J.D. Ballou and R. Frankam. 2003 Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. *Biological Conservation* 113:23–34.
- Trall, L.W., C.J.A. Bradshaw and B.W. Brook. 2007. Minimum viable population size: A meta-analysis of 30 years of published estimates. *Biological Conservation* 139: 159–166.
- Willson, R.J. 2000. The Search for the Blue Racer Snake (*Coluber constrictor foxii*) on Pelee Island, Spring 2000. Unpublished report. 22 pp + maps and appendices.
- Willson, R.J. 2002. A systematic search for the Blue Racer (*Coluber constrictor foxii*) on Pelee Island (2000–2002): A Final Report. Unpublished Report for the Ontario Ministry of Natural Resources. 38 pp.
- Willson, Rob, pers. comm. 2011. Email correspondence to S. Gillingwater. August 2011. Co-chair, Blue Racer Recovery Team, Ecologist, ON

Woodliffe, Allen, pers. comm. 2011. Email correspondence to S. Gillingwater. August 2011. Blue Racer Recovery Team, Ecologist, London, ON

2. Community and Aboriginal traditional knowledge source

No Aboriginal knowledge or Community Knowledge was received.

3. Acknowledgements.

Appendix 1: Northeastern North America status rank and decline

State/Province	Subnational Rank	Sources	Decline	Sources
CT				
DE				
IL				
IN	S4	NatureServe 2012		
IA				
LB				
KY				
MA				
MB				
MD				
ME				
MI				
MN				
NB				
NF				
NH				
NJ				
NS				
NY				
OH				
ON	S1	NatureServe 2012		
PA				
PE				
QC				
RI				
VA				
VT				
WI				
WV				

Occurs as a native species in 2 of 29 northeastern jurisdictions (However, see text in section 3.2 and 3.1 (3) on taxonomic confusion and conservation status)

Strank or equivalent information available for 2 of 2 jurisdictions = (100%)

S1, S2, SH, or SX in 1 of 2 = (50%)