Supporting Information for

Integer Linear programming outperforms simulated annealing for solving conservation planning problems

Table S1

Table S1: List of species that were used as features in our analysis.

Species Code	Common Name	Scientific Name
amegfi	American Goldfinch	Spinus tristis
amekes	American Kestrel	Falco sparverius
amerob	American Robin	Turdus migratorius
annhum	Anna's Hummingbird	Calypte anna
baleag	Bald Eagle	Haliaeetus leucocephalus
barswa	Barn Swallow	Hirundo rustica
brdowl	Barred Owl	Strix varia
belkin1	Belted Kingfisher	Megaceryle alcyon
bewwre	Bewick's Wren	Thryomanes bewickii
bnhcow	Brown-headed Cowbird	Molothrus ater
bkhgro	Black-headed Grosbeak	Pheucticus melanocephalus
brebla	Brewer's Blackbird	Euphagus cyanocephalus
brncre	Brown Creeper	Certhia americana
batpig1	Band-tailed Pigeon	Patagioenas fasciata
bushti	Bushtit	Psaltriparus minimus
cangoo	Canada Goose	Branta canadensis
chbchi	Chestnut-backed Chickadee	Poecile rufescens
cedwax	Cedar Waxwing	Bombycilla cedrorum
chispa	Chipping Sparrow	Spizella passerina
coohaw	Cooper's Hawk	Accipiter cooperii
comrav	Common Raven	Corvus corax
amecro	American Crow	Corvus brachyrhynchos
dowwoo	Downy Woodpecker	Dryobates pubescens
eucdov	Eurasian Collared-Dove	Streptopelia decaocto
eursta	European Starling	Sturnus vulgaris
evegro	Evening Grosbeak	Coccothraustes vespertinus
norfli	Northern Flicker	Colaptes auratus
foxspa	Fox Sparrow	Passerella iliaca
gockin	Golden-crowned Kinglet	Regulus satrapa
haiwoo	Hairy Woodpecker	Dryobates villosus
houfin	House Finch	Haemorhous mexicanus
houspa	House Sparrow	Passer domesticus
houwre	House Wren	Troglodytes aedon
hutvir	Hutton's Vireo	Vireo huttoni
macwar	MacGillivray's Warbler	Geothlypis tolmiei
moudov	Mourning Dove	Zenaida macroura
norhar1	Hen Harrier	Circus cyaneus
orcwar	Orange-crowned Warbler	Oreothlypis celata
olsfly	Olive-sided Flycatcher	Contopus cooperi
osprey	Osprey	Pandion haliaetus
pacwre1	Pacific Wren	Troglodytes pacificus
pinsis	Pine Siskin	Spinus pinus
pilwoo	Pileated Woodpecker	Dryocopus pileatus
pasfly	Pacific-slope Flycatcher	Empidonax difficilis
purfin	Purple Finch	Haemorhous purpureus
purmar	Purple Martin	Progne subis
rebnut	Red-breasted Nuthatch	Sitta canadensis
rebsap	Red-breasted Sapsucker	Sphyrapicus ruber
redcro	Red Crossbill	Loxia curvirostra

Species Code	Common Name	Scientific Name
rocpig	Rock Pigeon	Columba livia
rethaw	Red-tailed Hawk	Buteo jamaicensis
rufhum	Rufous Hummingbird	Selasphorus rufus
rewbla	Red-winged Blackbird	Agelaius phoeniceus
savspa	Savannah Sparrow	Passerculus sandwichensis
sora	Sora	Porzana carolina
sonspa	Song Sparrow	Melospiza melodia
spotow	Spotted Towhee	Pipilo maculatus
stejay	Steller's Jay	Cyanocitta stelleri
swathr	Swainson's Thrush	Catharus ustulatus
towwar	Townsend's Warbler	Setophaga townsendi
treswa	Tree Swallow	Tachycineta bicolor
daejun	Dark-eyed Junco	Junco hyemalis
yerwar	Yellow-rumped Warbler	Setophaga coronata
varthr	Varied Thrush	Ixoreus naevius
vigswa	Violet-green Swallow	Tachycineta thalassina
warvir	Warbling Vireo	Vireo gilvus
whcspa	White-crowned Sparrow	Zonotrichia leucophrys
westan	Western Tanager	Piranga ludoviciana
wilsni1	Wilson's Snipe	Gallinago delicata
wlswar	Wilson's Warbler	Cardellina pusilla
wooduc	Wood Duck	Aix sponsa
yelwar	Yellow Warbler	Setophaga petechia

Figure S1

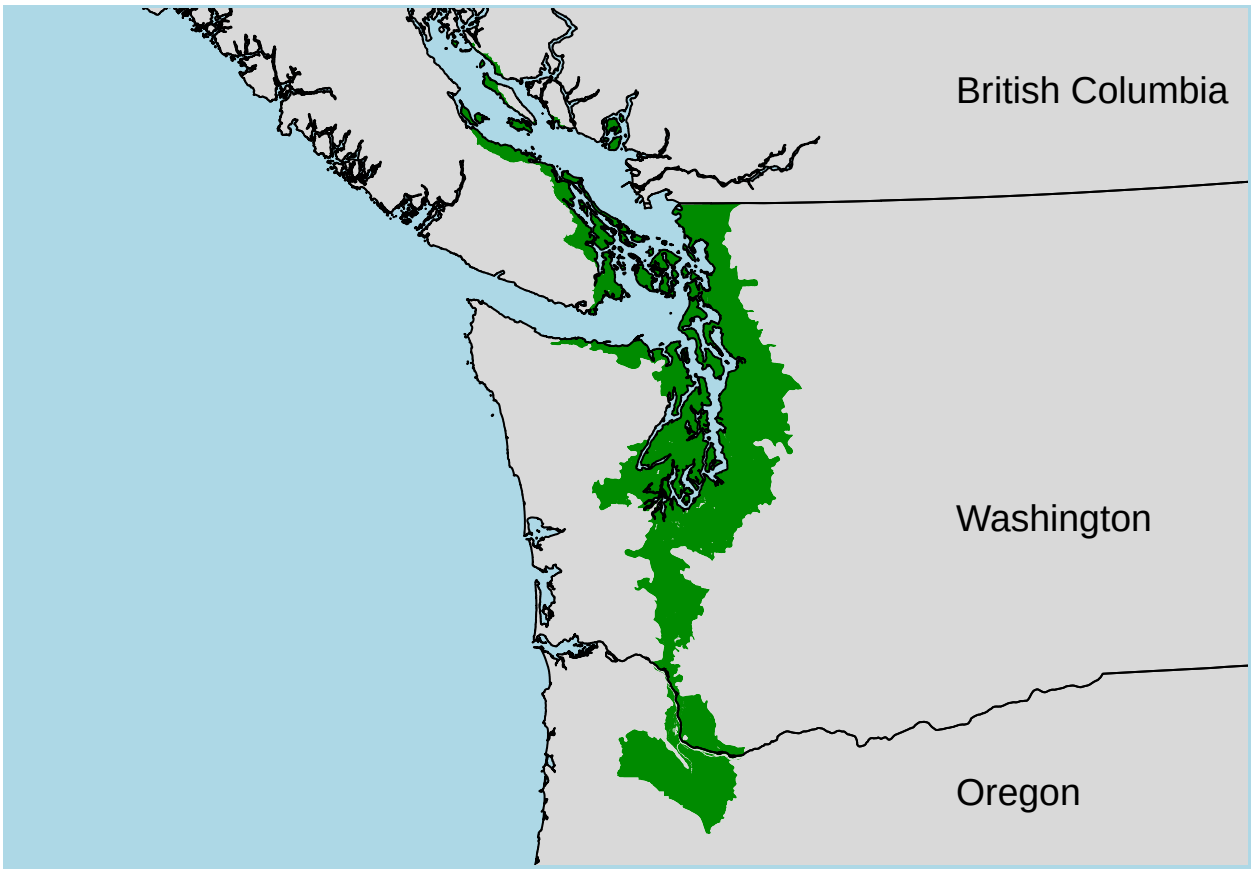

Figure S1: Study area.

Figure S2

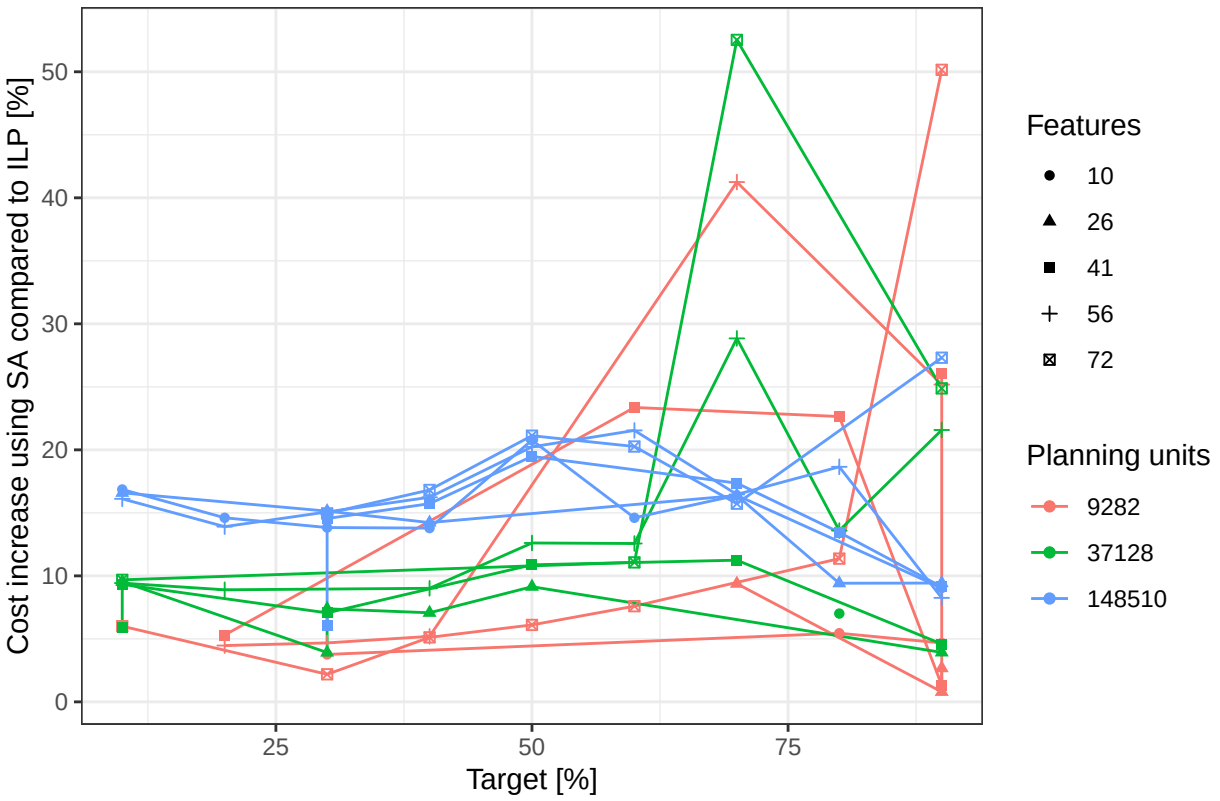

Figure S2: Percent cost increase of SA solutions compared to ILP solutions, across targets, number of features and number of planning units. Simulated annealing (i.e. Marxan) parameters used are: number of iterations $>$ 100,000; species penalty factor 5 or 25. Not all Marxan scenarios generated yielded feasible solutions (where all targets were met), which is why e.g. there is only one observation for 37,128 planning units and 10 features.

Figure S3

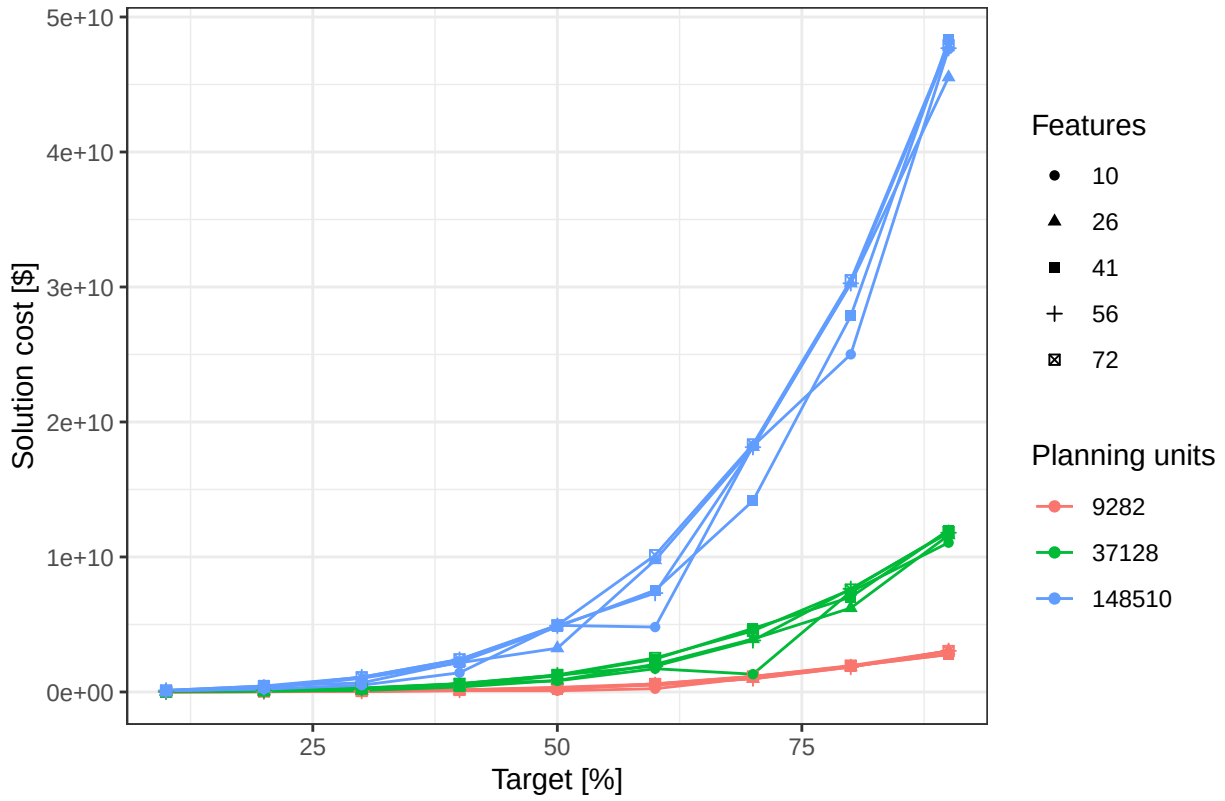

Figure S3: Cost profile for Gurobi solver across targets, number of features and number of planning units.

Figure S4

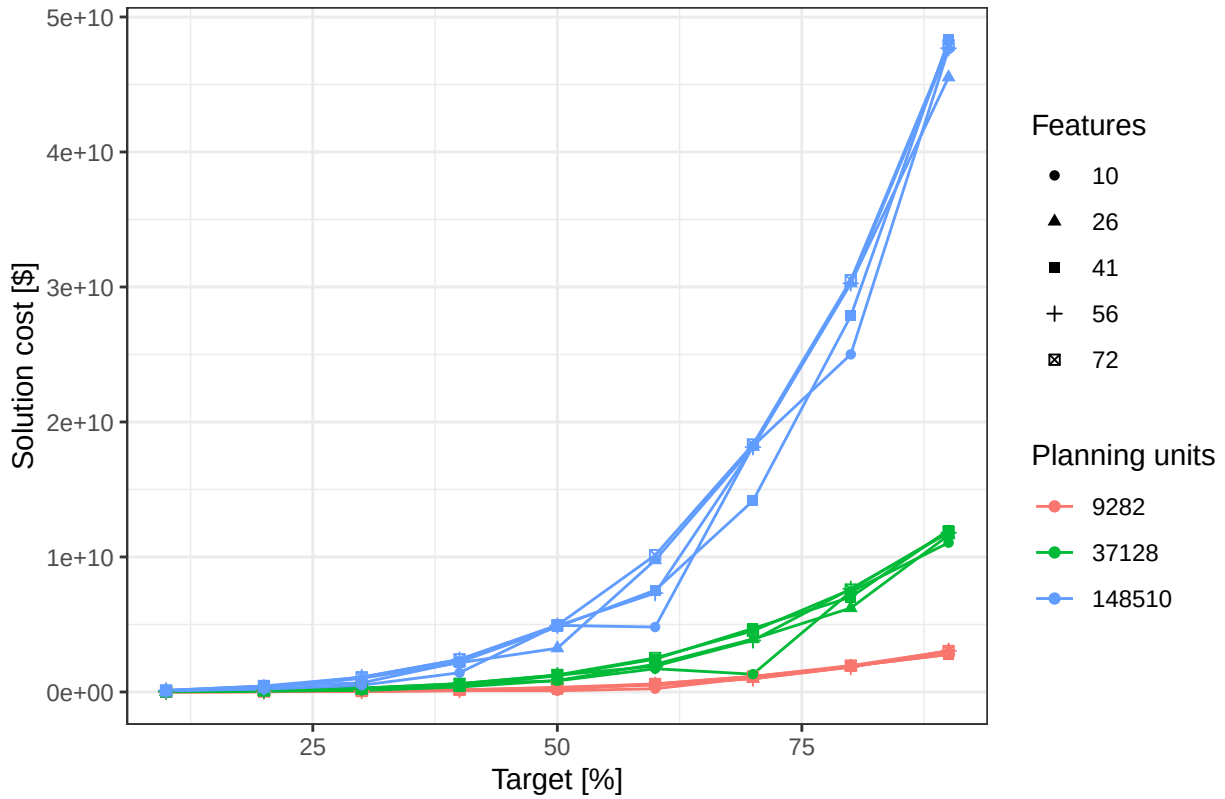

Figure S4: Cost profile for SYMPHONY solver across targets, number of features and number of planning units.

Figure S5

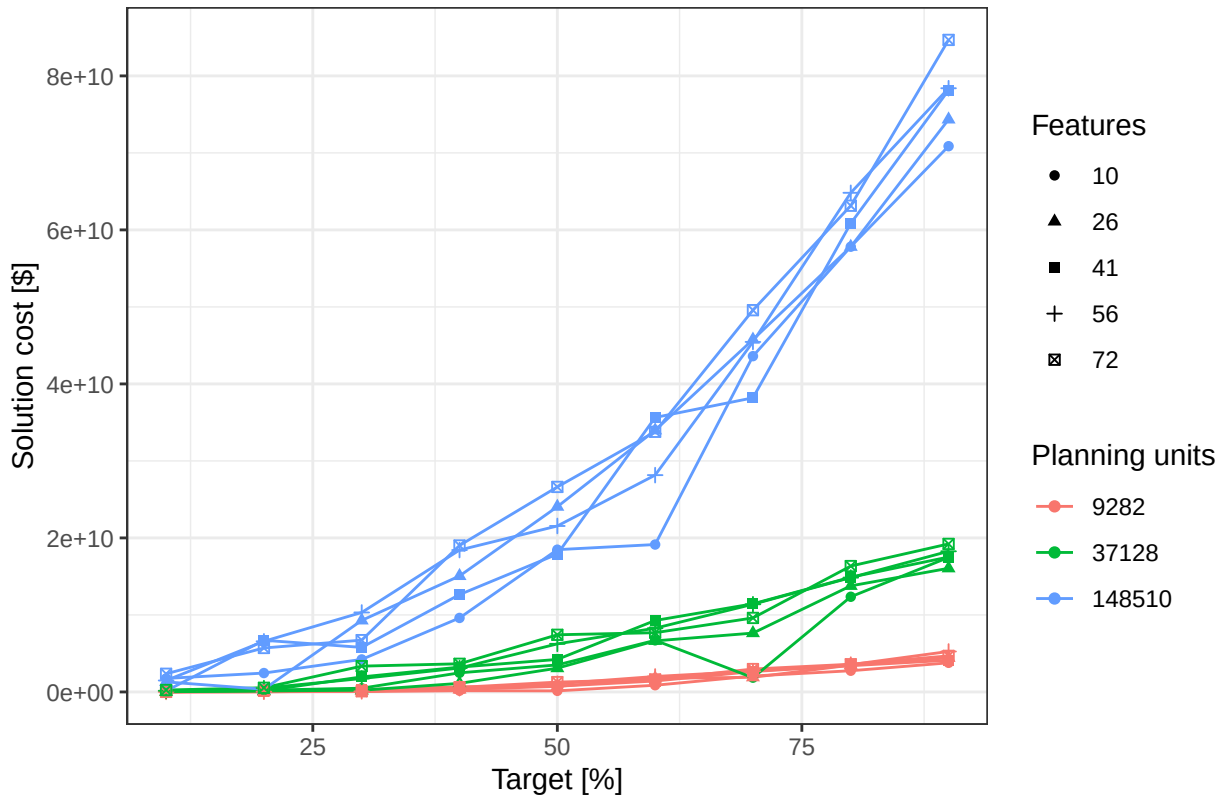

Figure S5: Cost profile for Marxan using Simulated Annealing across targets, number of features and number of planning units.

Figure S6

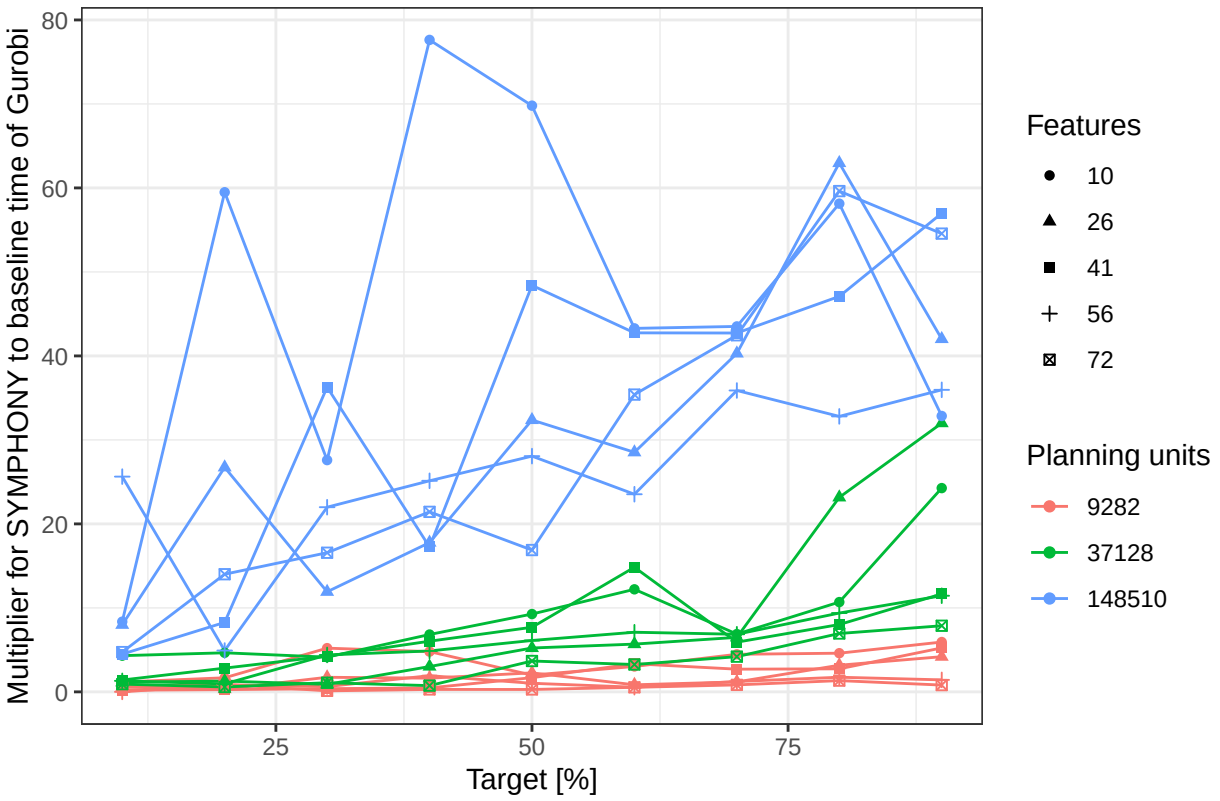

Figure S6: Time to solution comparisons between SYMPHONY and Gurobi across targets, number of features and number of planning units.

Figure S7

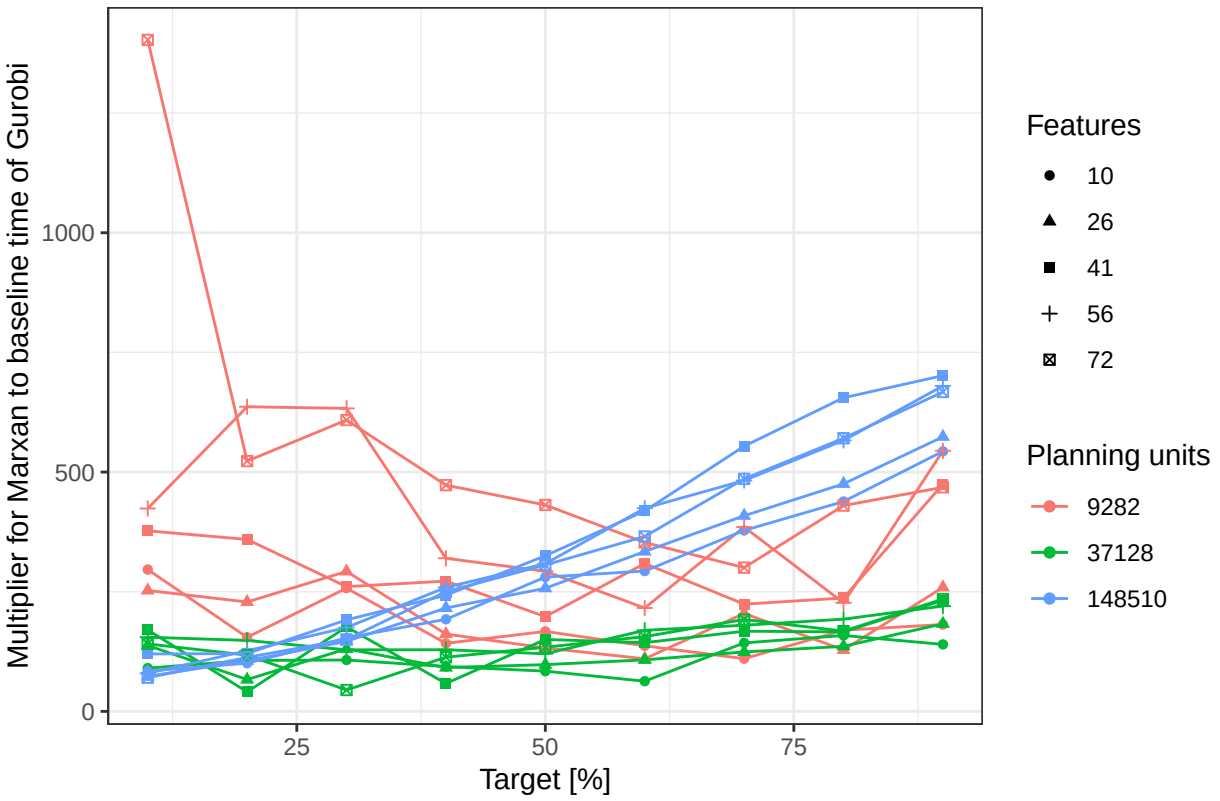

Figure S7: Time to solution comparisons between Marxan using Simulated Annealing and Gurobi across targets, number of features and number of planning units.

Figure S8

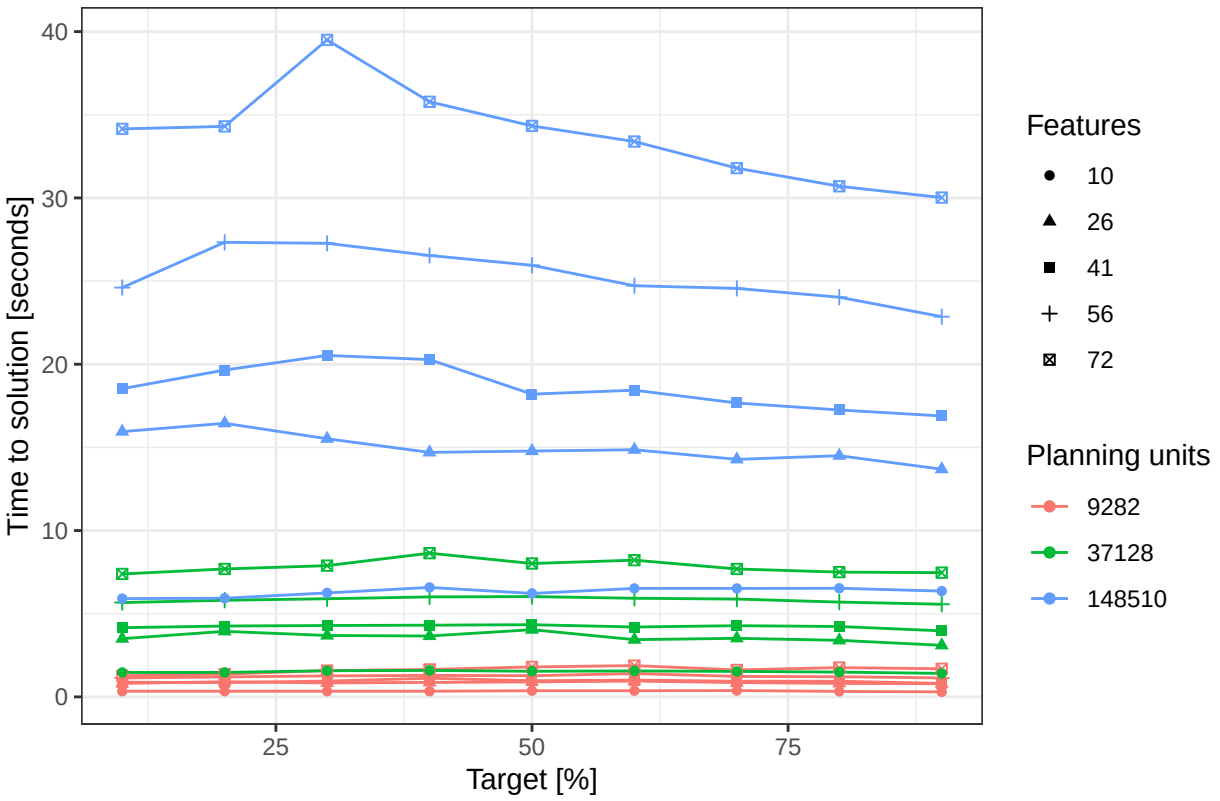

Figure S8: Time to solution profile for Gurobi solver across targets, number of features and number of planning units.

Figure S9

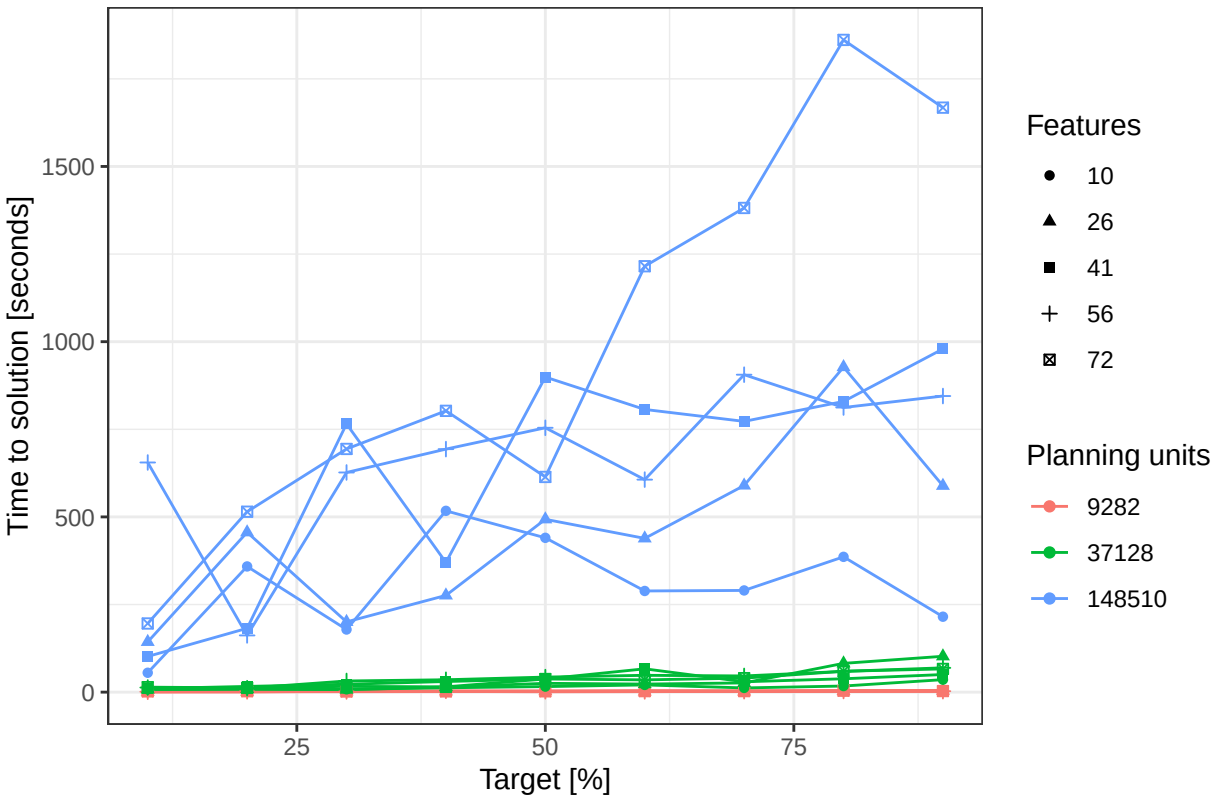

Figure S9: Time to solution profile for SYMPHONY solver across targets, number of features and number of planning units.

Figure S10

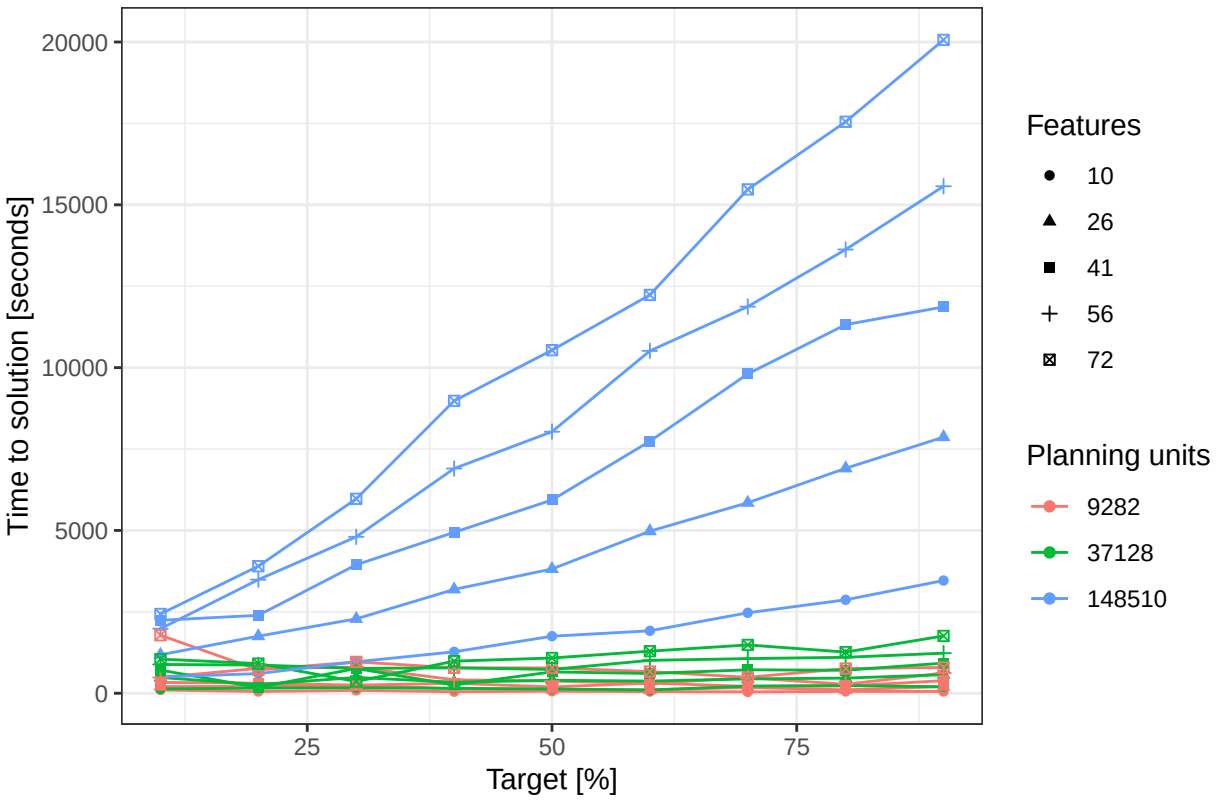

Figure S10: Time to solution profile for Marxan using Simulated Annealing across targets, number of features and number of planning units.

Figure S11

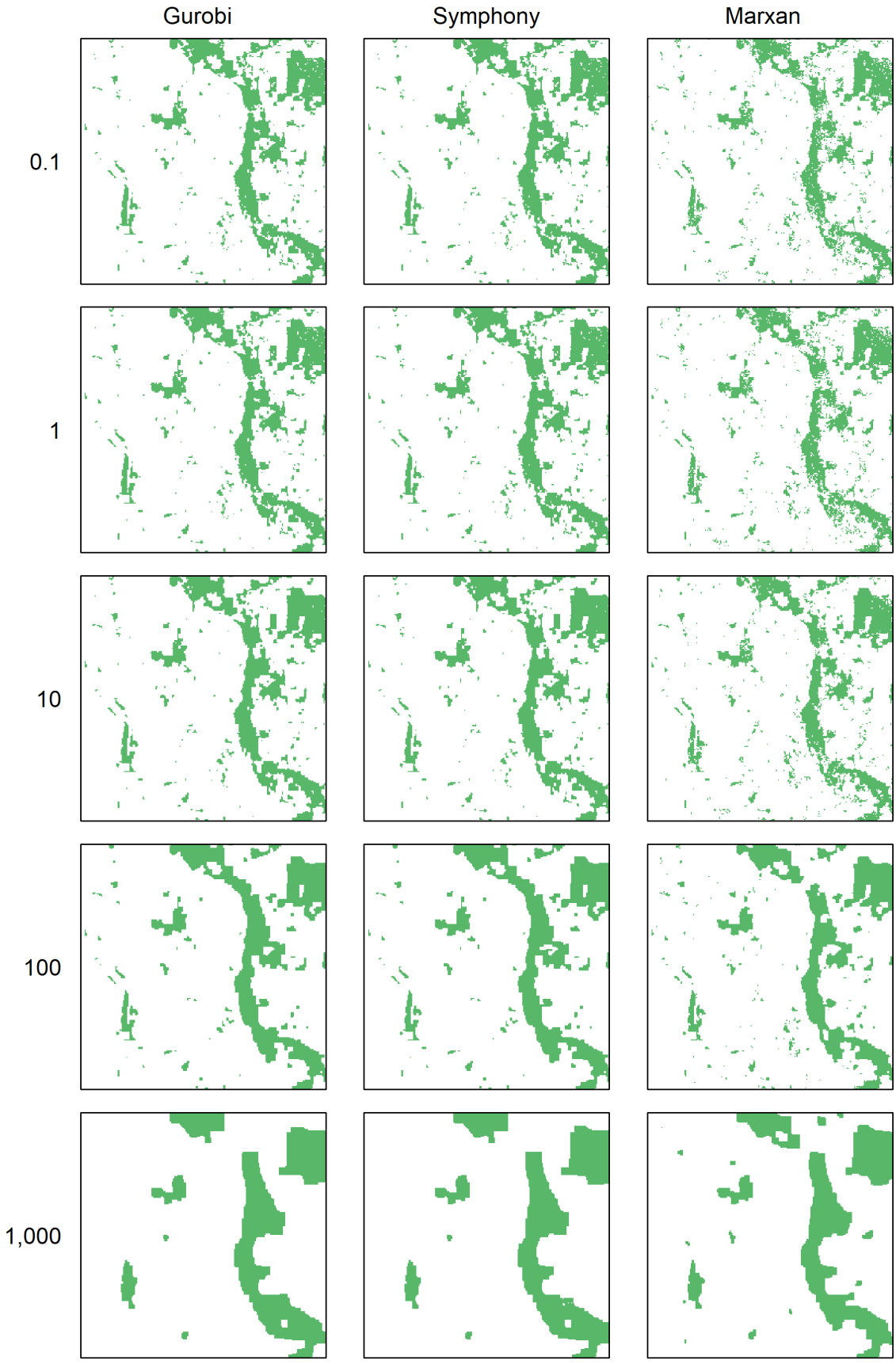

Figure S11: Compactness of solutions. Shown are the solutions for a 10% target. The numbers represent BLM

values.