

Supporting Information for

**Integer Linear programming outperforms simulated annealing for solving conservation planning problems**

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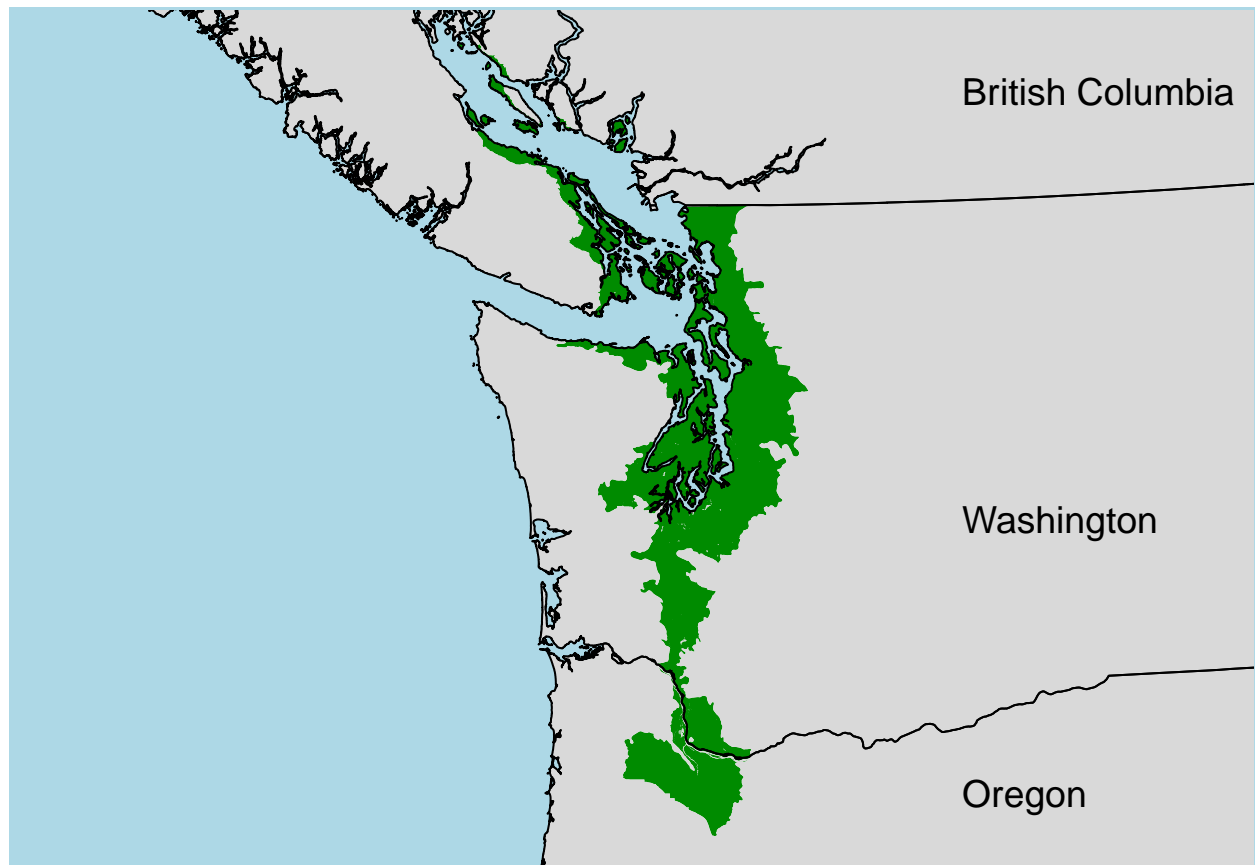
Table S1

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

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

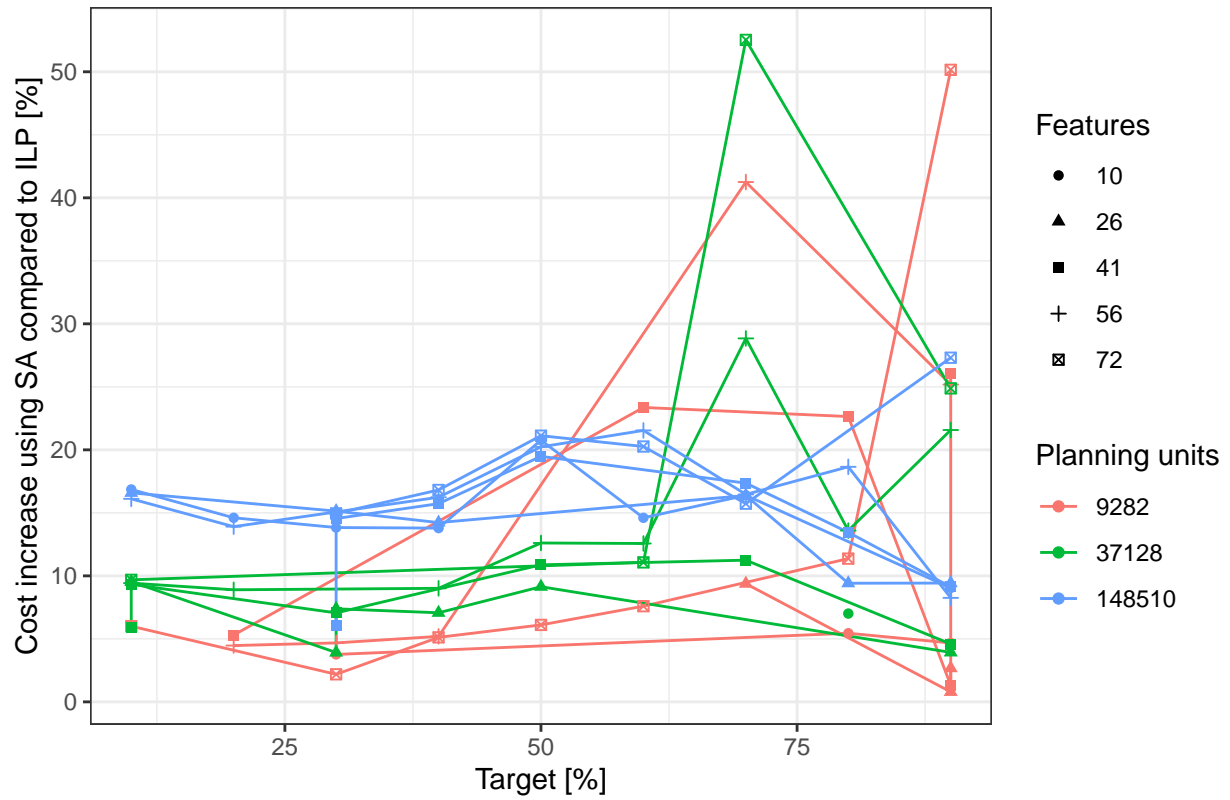
Species Code	Common Name	Scientific Name
rocpig	Rock Pigeon	<i>Columba livia</i>
rethaw	Red-tailed Hawk	<i>Buteo jamaicensis</i>
rufhum	Rufous Hummingbird	<i>Selasphorus rufus</i>
rewbla	Red-winged Blackbird	<i>Agelaius phoeniceus</i>
savspa	Savannah Sparrow	<i>Passerculus sandwichensis</i>
sora	Sora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

**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.

Figure S3

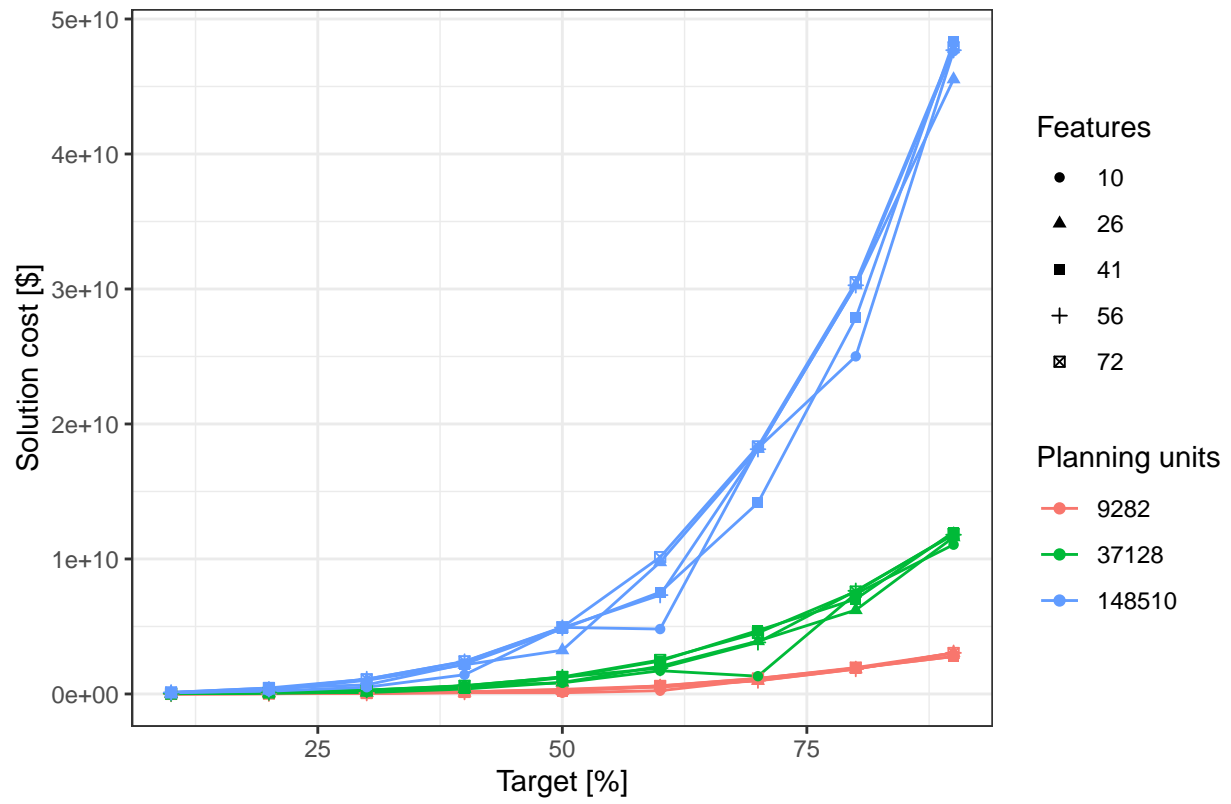
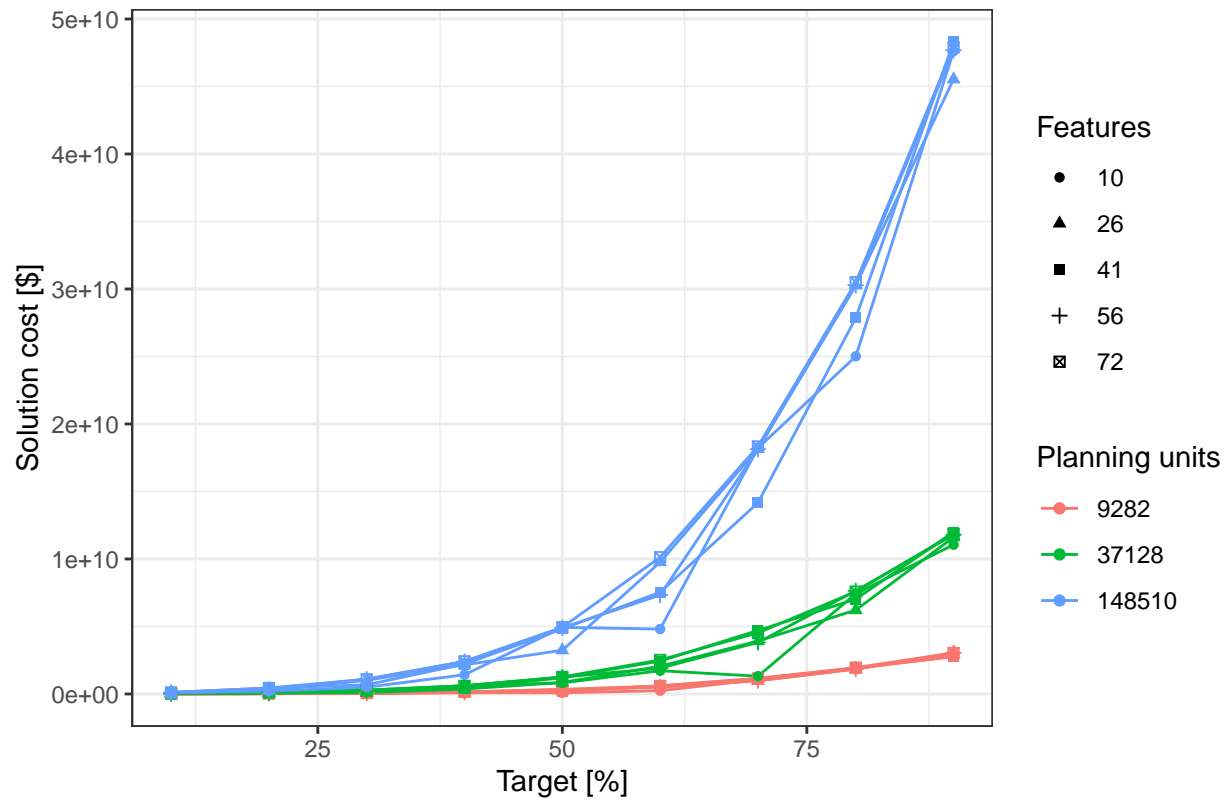


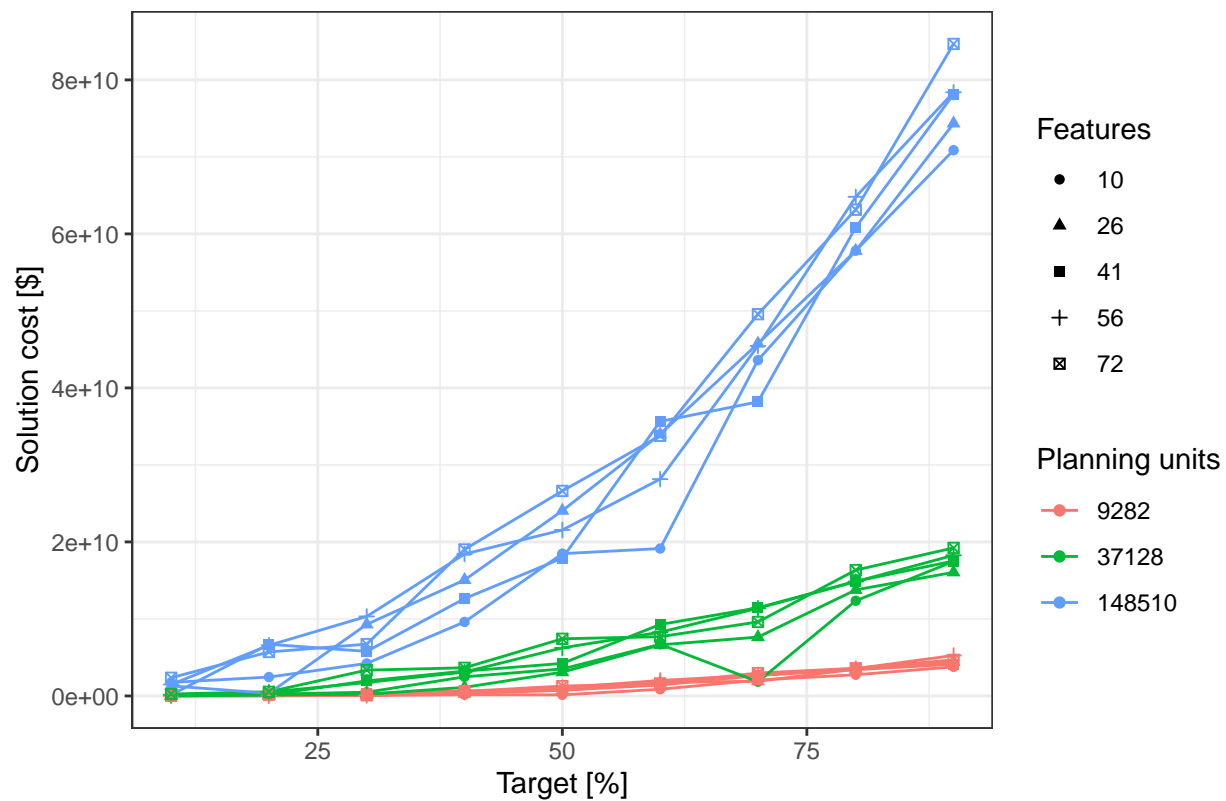
Figure S3: Cost profile for Gurobi solver across targets, number of features and number of planning units.

Figure S4



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

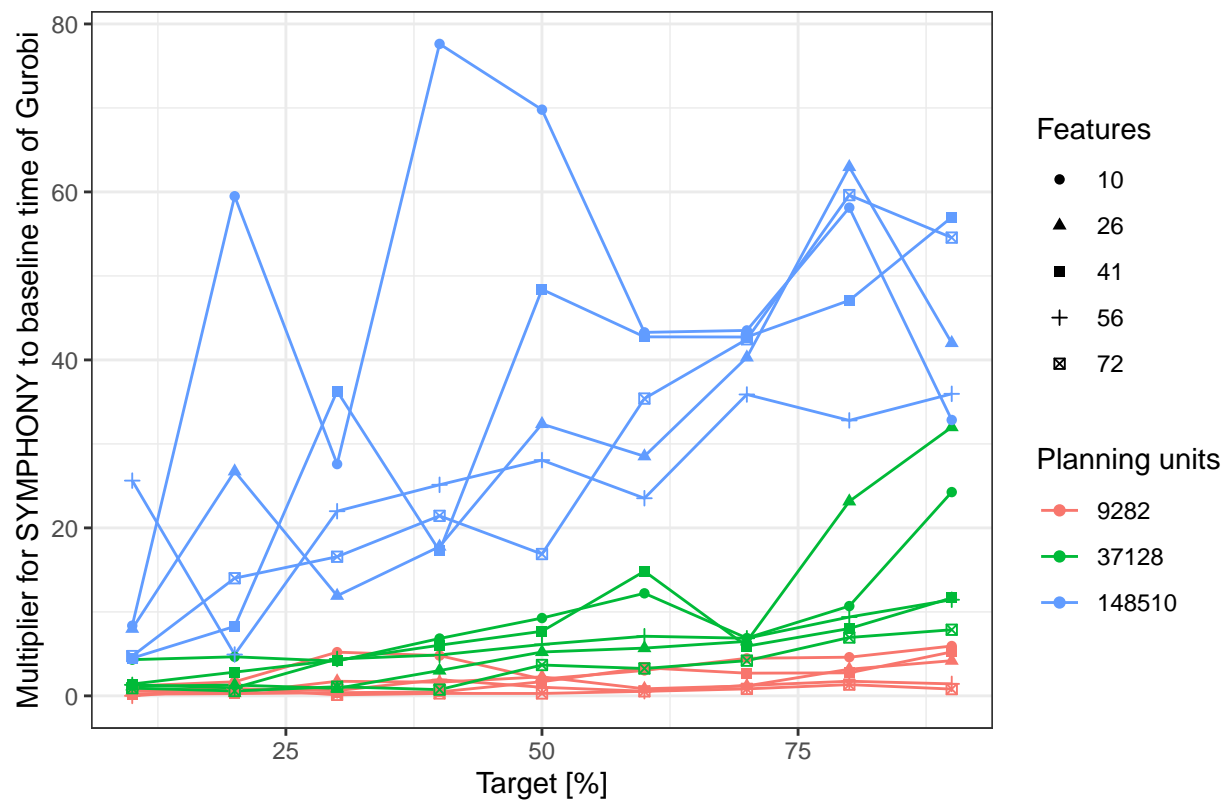
Figure S5



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

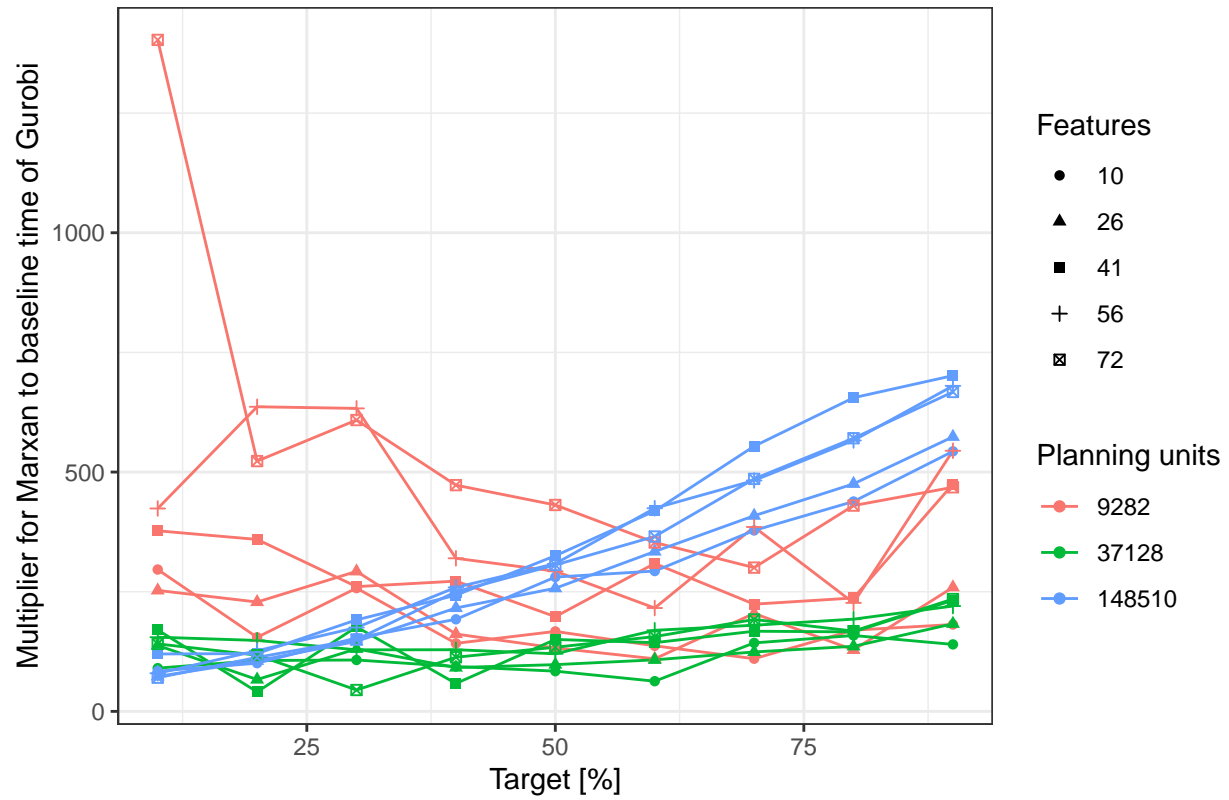


Figure S6



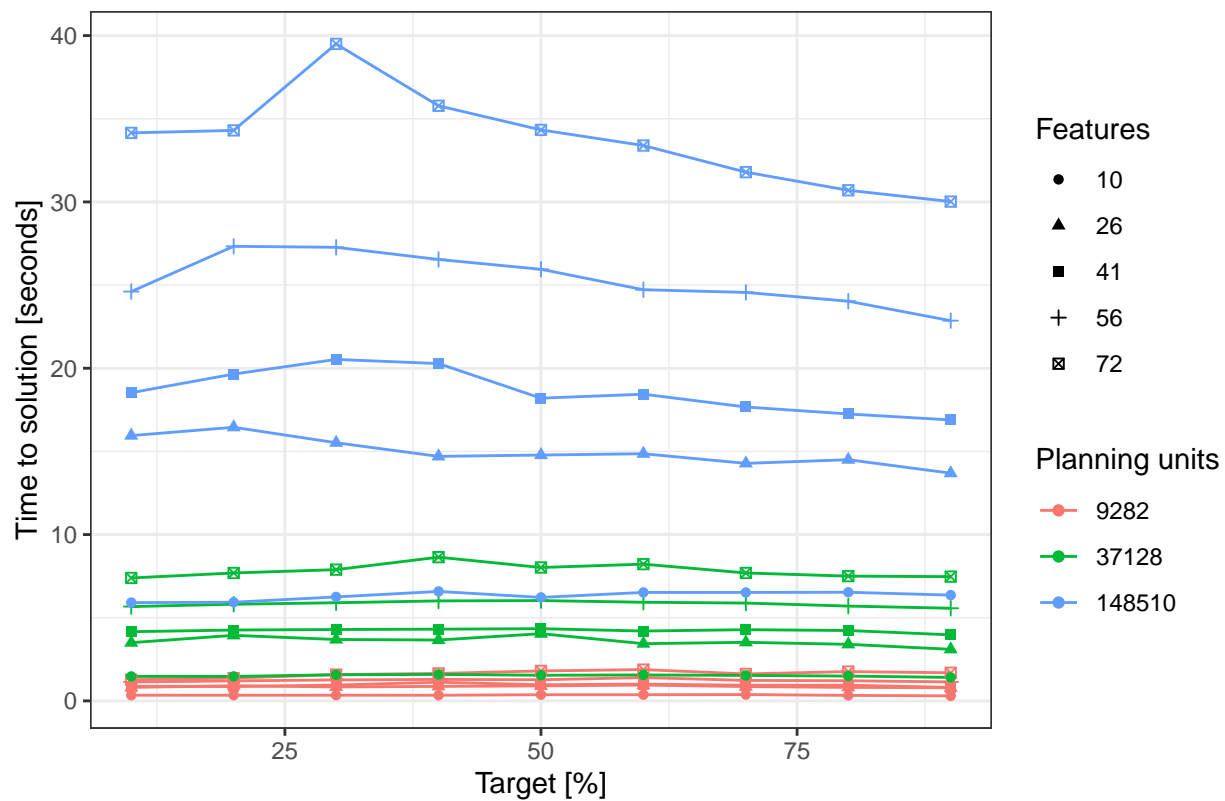
**Figure S6:** Time to solution comparisons between SYMPHONY and Gurobi across targets, number of features and number of planning units.

Figure S7



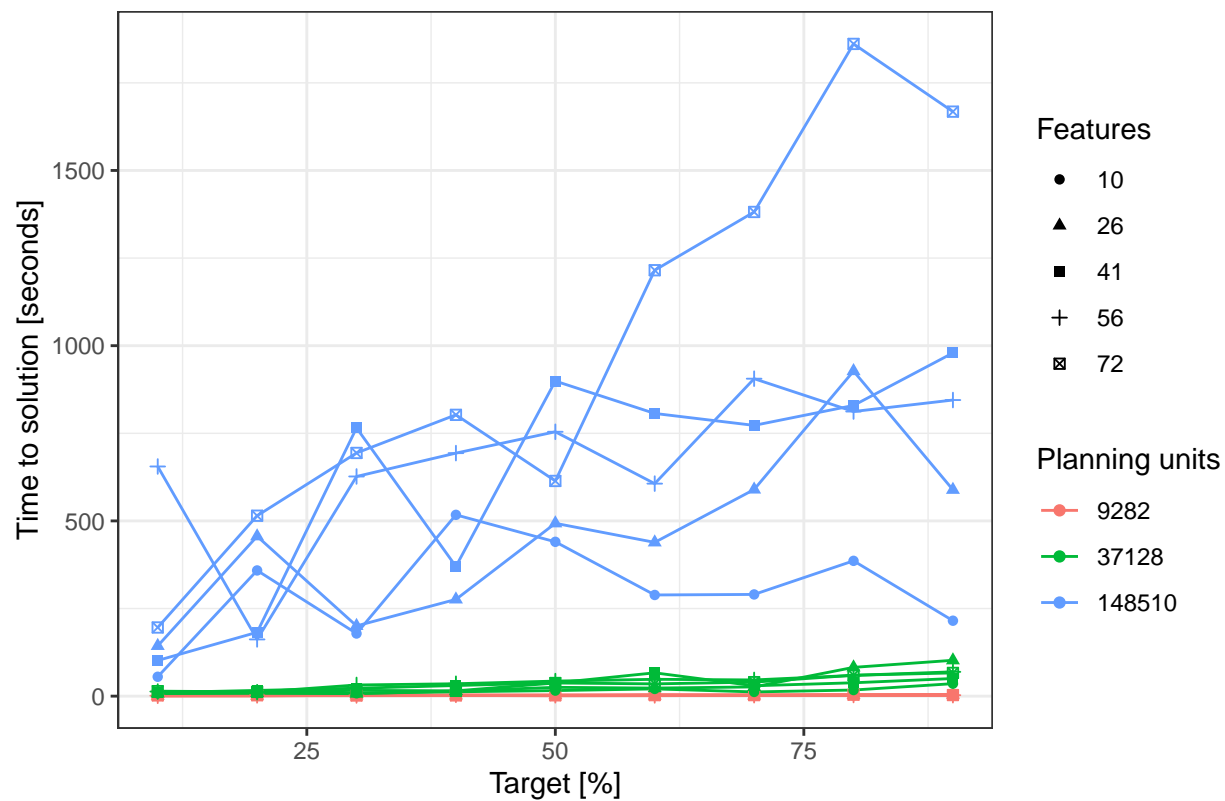
**Figure S7:** Time to solution comparisons between Marzan using Simulated Annealing and Gurobi across targets, number of features and number of planning units.

Figure S8



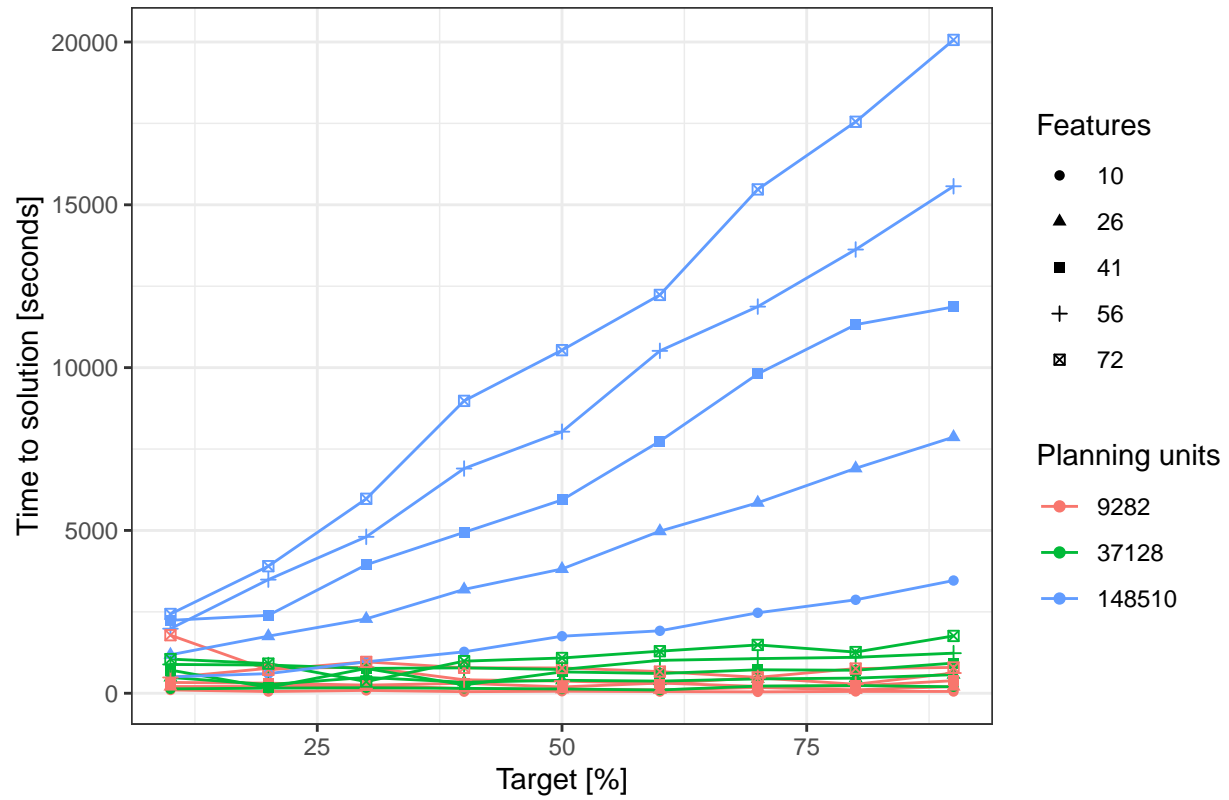
**Figure S8:** Time to solution profile for Gurobi solver across targets, number of features and number of planning units.

Figure S9



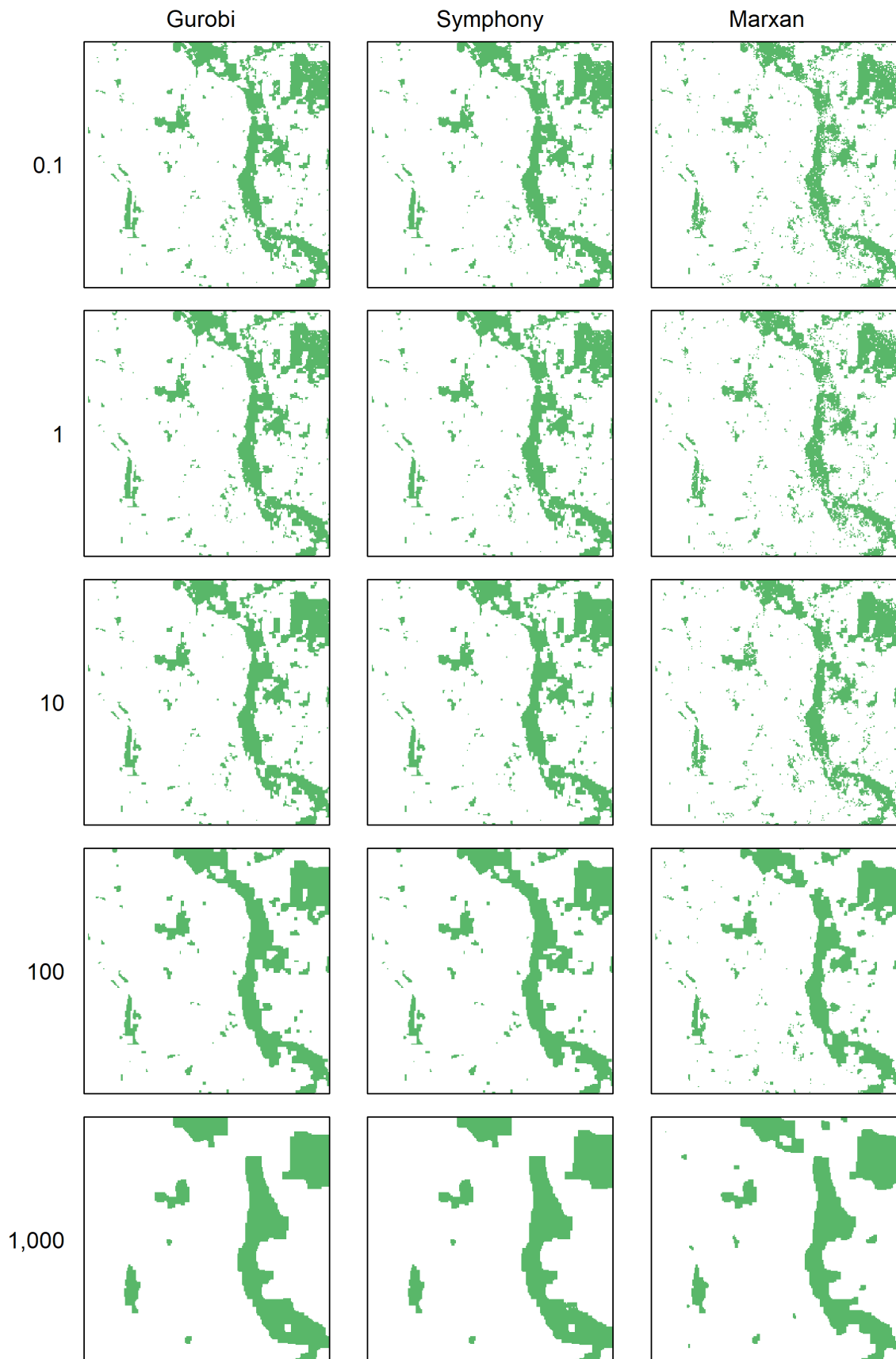
**Figure S9:** Time to solution profile for SYMPHONY solver across targets, number of features and number of planning units.

**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.