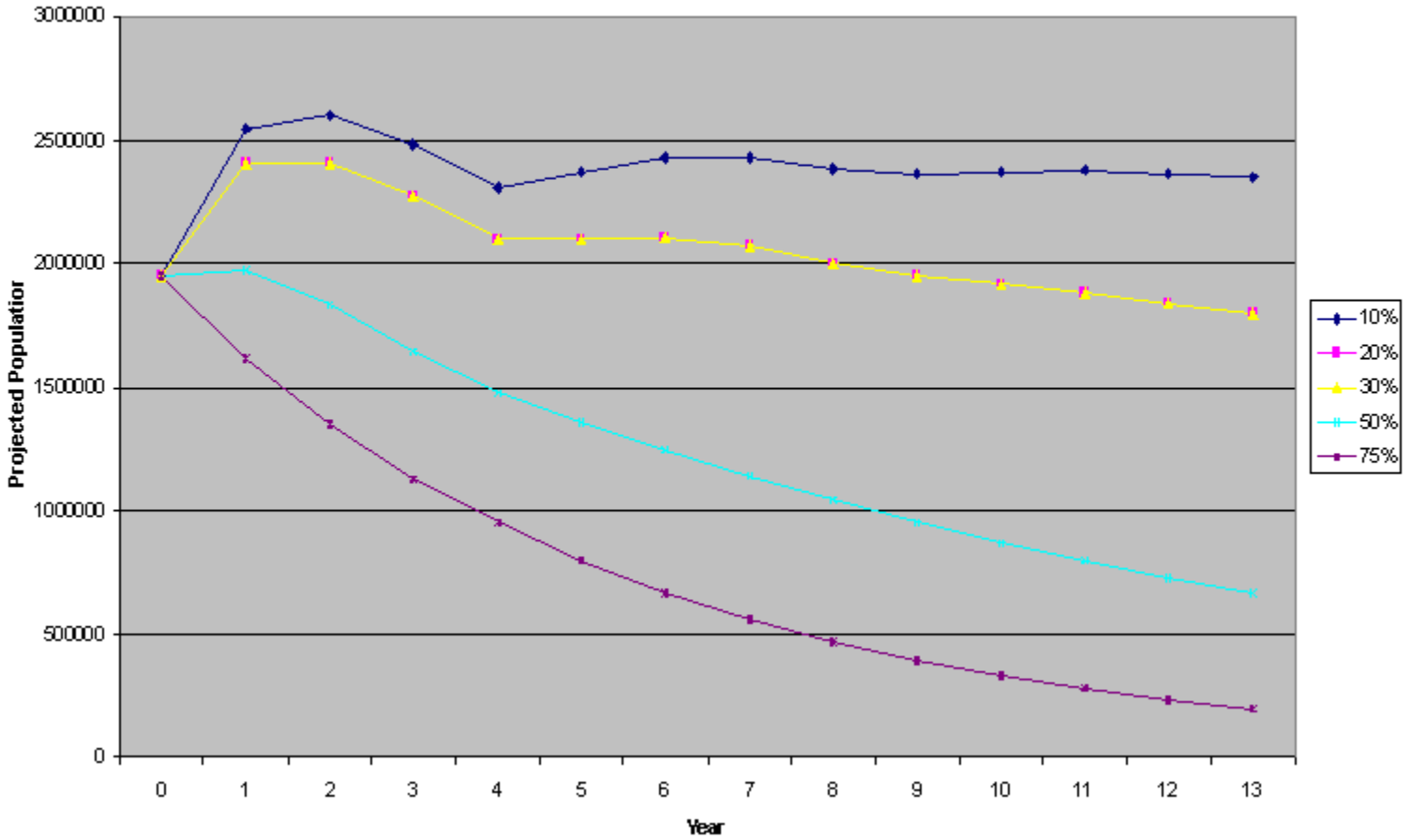


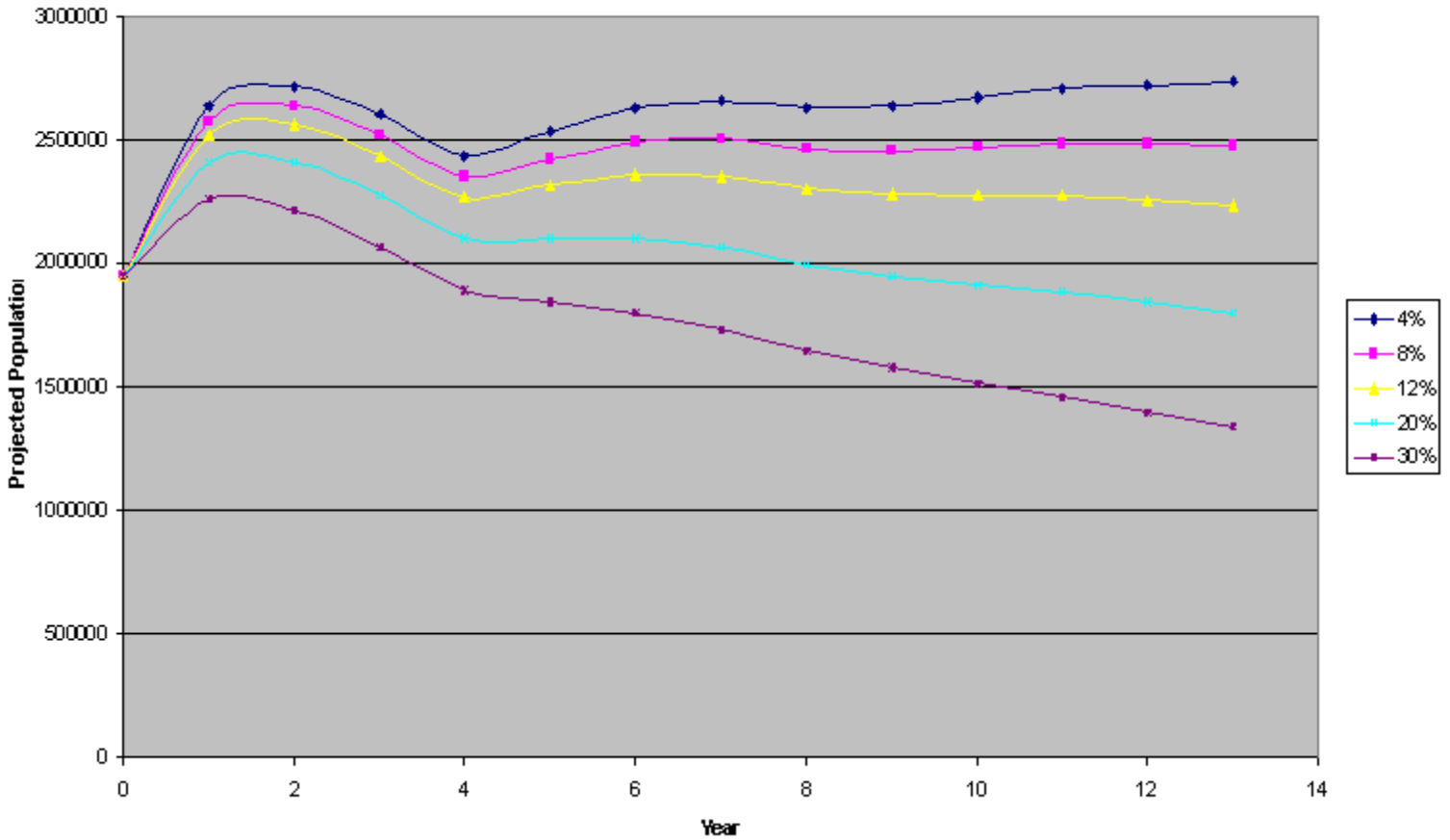
Appendix 9: Population Modeling

Projected Cormorant Population, 10% Harvest, 10-75% Oiling



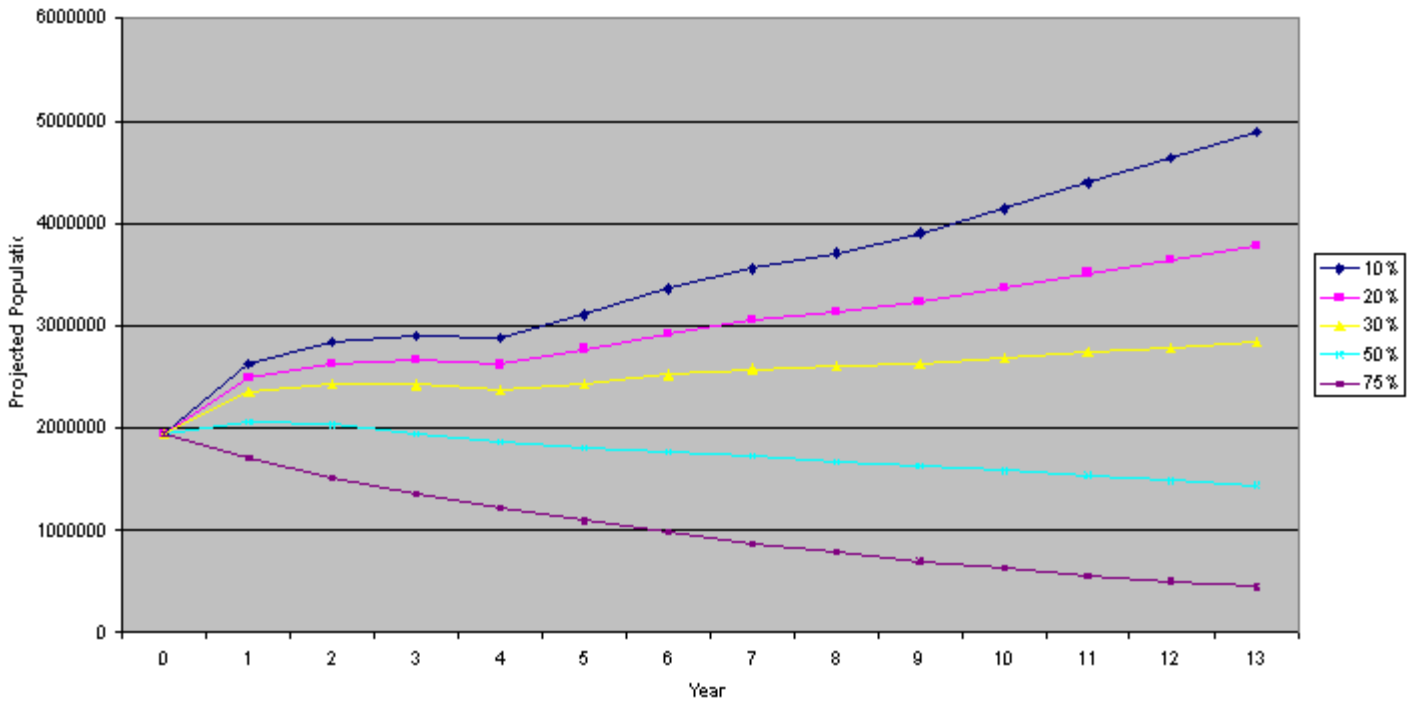
This figure projects population trends given a 10 percent annual take of the continental DCCO population, and five different egg oiling regimes applied to the entire continental population. The results are projected 13 years into the future.

Projected Cormorant Population, 10% Harvest, 4-30% Oiling



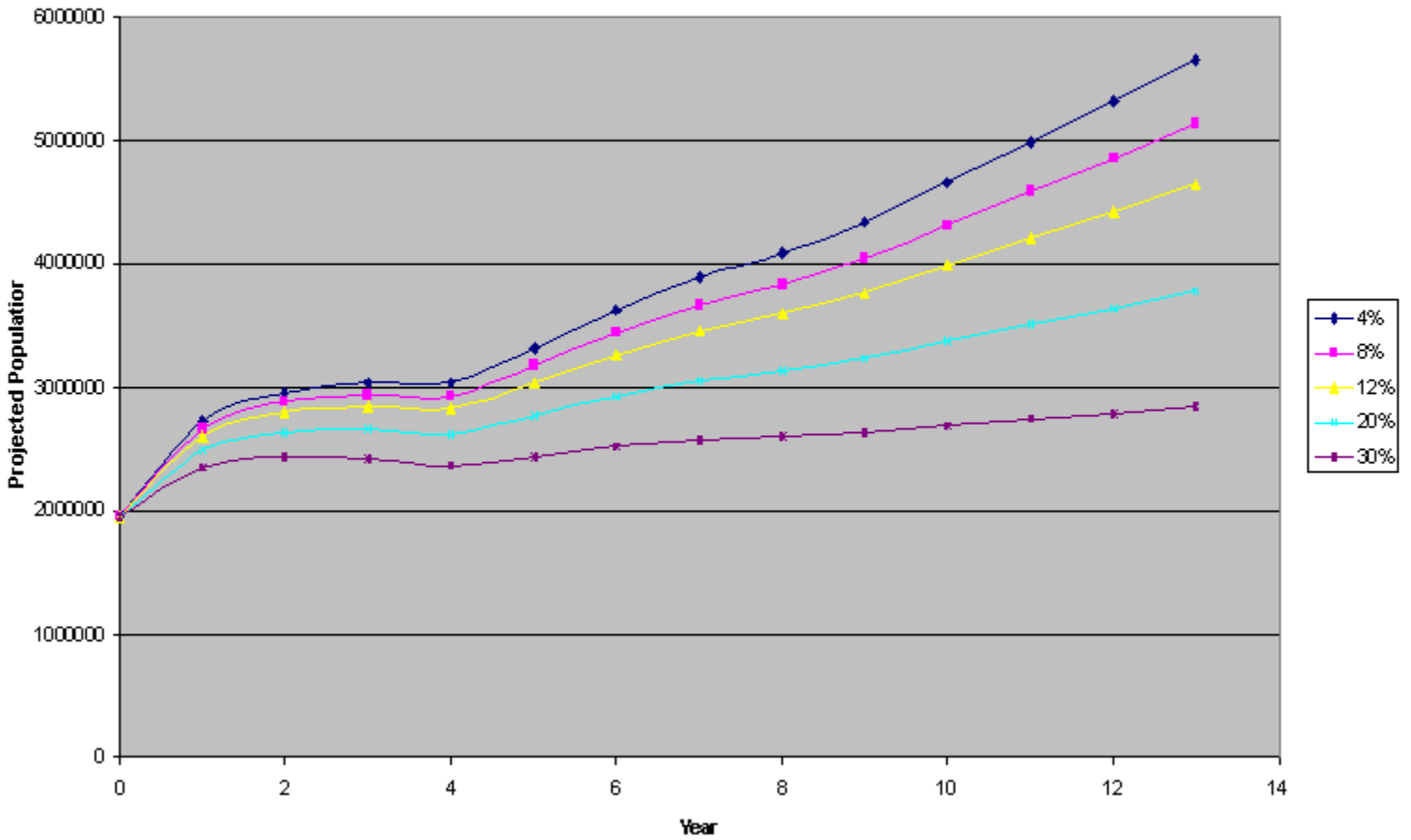
This figure projects population trends given a 10 percent annual take of the continental DCCO population, and five different egg oiling regimes applied to only 40 percent of the continental population, since approximately 60 percent of breeding DCCOs occur in Canada (oiling rates ranging from 10-75% fall to 4-30% when corrected for the expectation that this management will only be applied to 40% of the population). The results are again projected 13 years into the future.

Projected Cormorant Population, 4% Harvest, 10-75% Oiling



For comparison purposes, this figure shows the projected effects of a 4 percent annual take and a 10-75 percent egg oiling regime applied to the entire continental population.

Projected Cormorant Population, 4% Harvest, 4-30% Oiling



For comparison purposes, this figure shows the projected effects of a 4 percent annual take and a 4-30 percent egg oiling regime applied to the entire continental population.

Population parameters used in modeling:

Age at first breeding = 3 years

Mean clutch size = 3.3 (average from 7 studies was 3.36; conservatively round to 3.3)

Hatch rate = 60% (average from 6 studies was 63.1%, conservatively round to 60%)

Fledging success = 1.8 young fledged per nest (midway between 1.2-2.4 range of estimated fledging success given in DCCO status assessment) or 84% (average from 3 studies)

Total continental DCCO population = 2 million

An estimated 50% of these are breeders (one study of Great Cormorants in Europe estimated that at least 40% of colony was made up of non-breeders; other estimates range from 1-4 nonbreeders/breeder)

Maximum age = 17.75 years

Life expectancy = 6.1 years

Survivorship:

0-1 years = .50

1-2 years = .75

2+ years = .80

Estimated annual growth rate = 6.2% (average of 2.6% reported by Tyson et al. and 9.94 BBS trend for 1966-2000)

Modeling conducted by Pamela Garrettson, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, using STELLA software.

Appendix 10: Preliminary list of species of special status that may be affected by DCCO management

Region 1

Hawaiian goose	(<i>Branta sandvicensis</i>) [E]
Light-footed clapper rail	(<i>Rallus longirostris levipes</i>) [E]
California clapper rail	(<i>Rallus longirostris obsoletus</i>) [E]
Yuma clapper rail	(<i>Rallus longirostris yumanensis</i>) [E]
California least tern	(<i>Sterna antillarum</i>) [E]
Brown pelican	(<i>Pelicanus occidentalis</i>) (Pacific coast population) [E]
Southwestern willow flycatcher	(<i>Empidonax trailii extimus</i>) [E]
California condor	(<i>Gymnogyps californianus</i>) [E]
Least Bell's vireo	(<i>Vireo belli pusillus</i>) [E]
Western snowy plover	(<i>Charadrius alexandrinus nivosus</i>) [T]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]
California gnatcatcher	(<i>Polioptila californica</i>) [T]
Inyo California towhee	(<i>Pipilo crissalis eremophilus</i>) [T]
Marbled murrelet	(<i>Brachyramphus marmoratus</i>) [T]
Northern spotted owl	(<i>Strix occidentalis caurina</i>) [T]
Mountain plover	(<i>Charadrius montanus</i>) [P]
Western sage grouse	(<i>Centrocercus urophasianus phaios</i>) [C]
Salt marsh harvest mouse	(<i>Reithrodontomys raviventris</i>) [E]
Riparian brush rabbit	(<i>Sylvilagus bachmani riparius</i>) [E]
Riparian woodrat	(<i>Neotoma fuscipes riparia</i>) [E]

Region 2

Attwater's greater prairie-chicken	(<i>Tympanuchus cupido attwateri</i>) [E]
Masked bobwhite	(<i>Colinus virginianus ridgewayi</i>) [E]
Red-cockaded woodpecker	(<i>Picoides borealis</i>) [E]
Cactus ferruginous pygmy-owl	(<i>Glaucidium brasilianum cactorum</i>) [E]
Yuma clapper rail	(<i>Rallus longirostris yumanensis</i>) [E]
Least tern	(<i>Sterna antillarum</i>) [E]
Northern aplomado falcon	(<i>Falco femoralis septentrionalis</i>) [E]
Brown pelican	(<i>Pelicanus occidentalis</i>) [E]
Southwestern willow flycatcher	(<i>Empidonax traillii extimus</i>) [E]
Black-capped vireo	(<i>Vireo atricapillus</i>) [E]
Golden-cheeked warbler	(<i>Dendroica chrysoparia</i>) [E]
California condor	(<i>Gymnogyps californianus</i>) [XN]
Mexican spotted owl	(<i>Strix occidentalis lucida</i>) [T]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]
Piping plover	(<i>Charadrius melodus</i>) [T]
Mountain plover	(<i>Charadrius montanus</i>) [P]
Lesser prairie-chicken	(<i>Tympanuchus pallidicinctus</i>) [C]
Hualapai Mexican vole	(<i>Microtus mexicanus hualpaiensis</i>) [E]
Concho water snake	(<i>Nerodia paucimaculata</i>) [T]
Louisiana pine snake	(<i>Pituophis ruthveni</i>) [C]
Sonoyta mud turtle	(<i>Kinosternon sonoriense longifemorale</i>) [C]

Region 3

Piping plover	(<i>Charadrius melodus</i>) [T]
Least tern	(<i>Sterna antillarum</i>) (Interior population) [E]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]
Lake Erie water snake	(<i>Nerodia sipedon</i>) [T]

Region 4

Red-cockaded woodpecker	(<i>Picoides borealis</i>) [E]
Puerto Rican parrot	(<i>Amazona vittata</i>) [E]
Puerto Rican nightjar	(<i>Caprimulgus noctitherus</i>) [E]
Puerto Rican Plain pigeon	(<i>Columba inornata wetmorei</i>) [E]
Mississippi sandhill crane	(<i>Grus canadensis pulla</i>) [E]
Piping plover	(<i>Charadrius melodus</i>) [E]
Least tern	(<i>Sterna antillarum</i>) (Interior population) [E]
Everglade snail kite	(<i>Rostrhamus sociabilis plumbeus</i>) [E]
Puerto Rican broad-winged hawk	(<i>Buteo platypterus brunnescens</i>) [E]
Puerto Rican sharp-shinned hawk	(<i>Accipiter striatus venator</i>) [E]
Wood stork	(<i>Mycteria americana</i>) [E]
Brown pelican	(<i>Pelicanus occidentalis</i>) [E]
Cape Sable sparrow	(<i>Ammodramus maritimus mirabilis</i>) [E]
Florida grasshopper sparrow	(<i>Ammodramus savenarum floridanus</i>) [E]
Yellow-shouldered blackbird	(<i>Agelaius xanthomus</i>) [E]
Roseate tern	(<i>Sterna douglalli</i>) [T]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]
Audubon's crested caracara	(<i>Polyborus plancus audubonii</i>) [T]
Florida scrub jay	(<i>Aphelocoma coerulescens</i>) [T]
Florida salt marsh vole	(<i>Microtus pennsylvanicus dukecampbelli</i>) [E]
Atlantic salt marsh snake	(<i>Nerodia clarkii taeniata</i>) [T]

Region 5

Piping plover	(<i>Charadrius melodus</i>) [T]
Roseate tern	(<i>Sterna douglalli</i>) [E]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]

Region 6

Least tern	(<i>Sterna antillarum</i>) (Interior population) [E]
Piping plover	(<i>Charadrius melodus</i>) [T]
Mexican spotted owl	(<i>Strix occidentalis lucida</i>) [T]
Bald eagle	(<i>Haliaeetus leucocephalus</i>) [T]
Whooping crane	(<i>Grus americana</i>) [E]