Exploring New England Dams: Analysis using the high resolution National Hydrography Dataset

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Introduction

- Over 14,000 New England dams[1]

- The Future of Dams (FoD) Project developed and maintains a NEST Dam Database (http://ddc-dams.sr.unh.edu/metadata/data-description/) providing a unified data resource and facilitating research within the FoD team and beyond.

- Dams were excluded from that database if they could not be associated with streams in the National Hydrography Dataset Plus Version 2 (NHDPlusV2; 1:100,000 resolution). The coarse resolution maps were missing some rivers; dams not on rivers were removed. The current NEST Dam Database contains 7,338 dams.

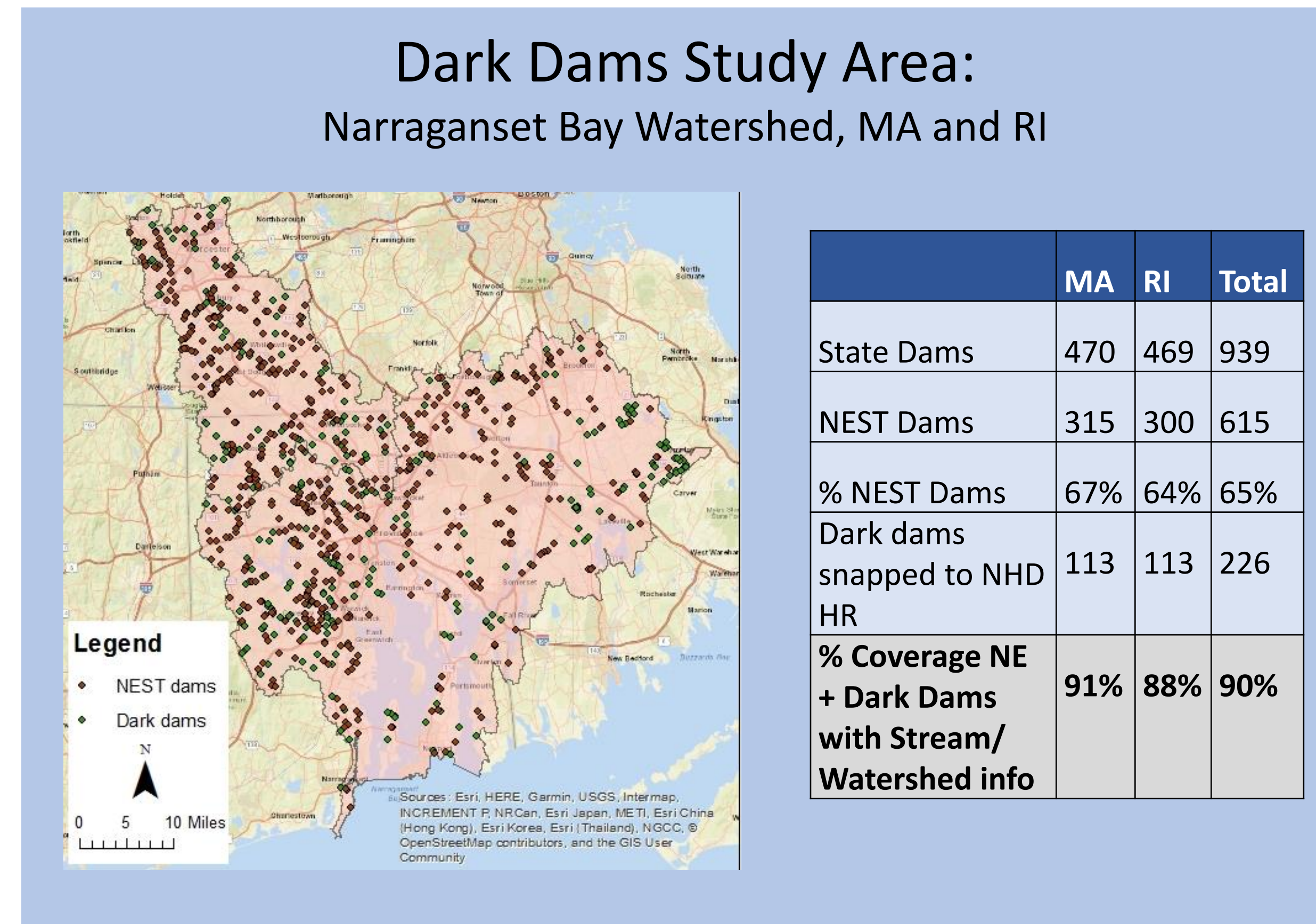|	State Database Dams	NEST Dams	Missing "Dark" Dams	% Dark Dams
CT	3,646	2,108	1,538	42.2%
MA	2,903	1,795	1,108	38.2%
ME	782	659	123	15.7%
NH	5,202	2,024	3,178	61.1%
RI	668	434	234	35.0%
VT *	1,086 (513)	318	768 (195)	70.7% (37.6%)
Total	14,291	7,338	6,953	48.7%

Table 1: Number of dams from the state databases within the NEST database versus those that were excluded (Dark Dams). *Spatial extent of New England Dams Database does not include portions of Vermont and a small segment of Massachusetts. Number in parentheses indicates dams in the study area.

- The goal of this project was to examine if we could locate some of the missing dams, hereafter referred to as "Dark Dams" (Table 1), with USGS's high resolution National Hydrography Dataset (NHD HR, released May 2017) with 1:24,000 resolution and ten times as many hydrologic features.
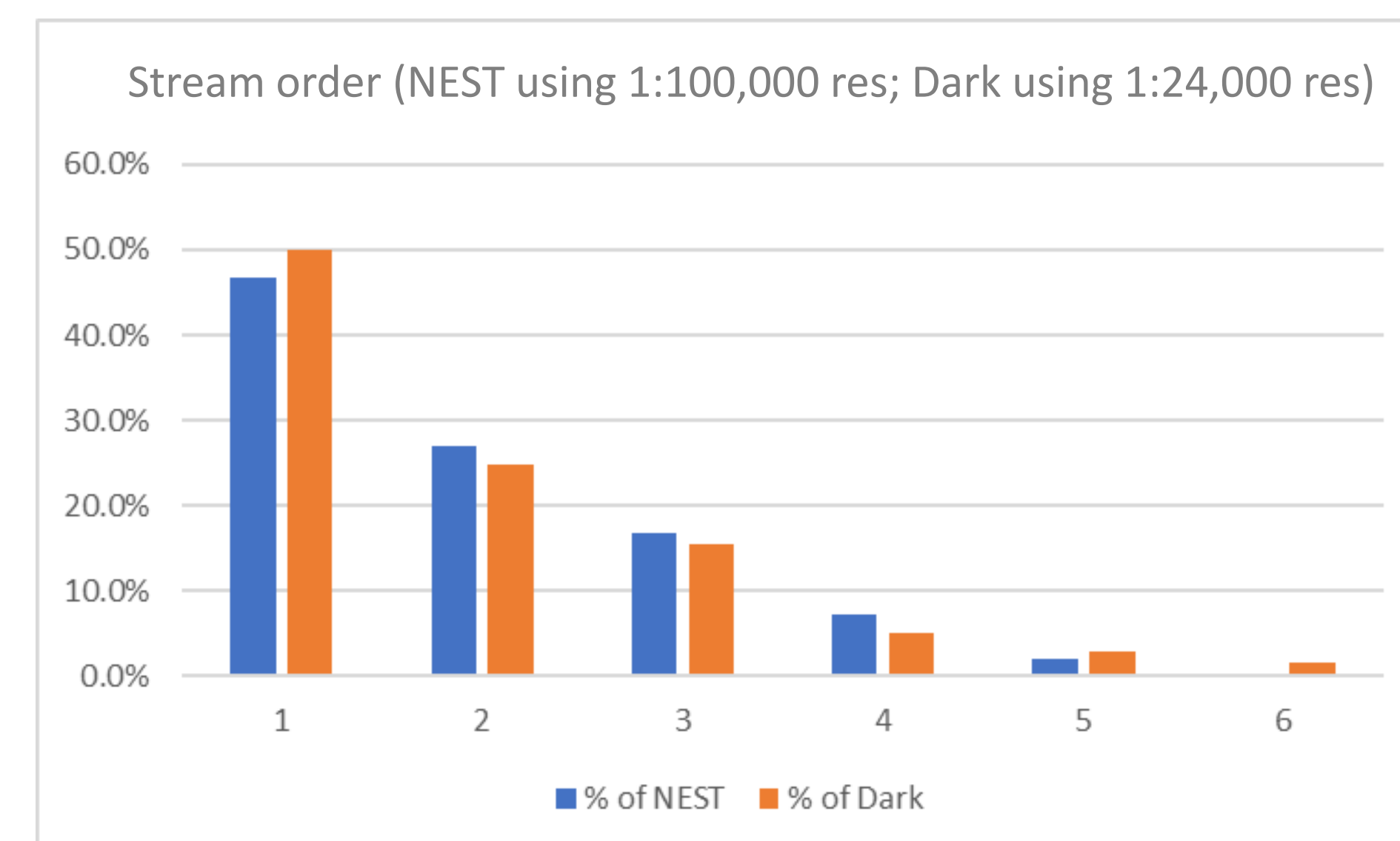
Objectives

i) To determine if the new high resolution can provide attribute data on a subset of Dark Dams.

ii) To compare and contrast the attributes of newly identified dams from high resolution hydrography with those obtained from the more coarse-scale hydrography (e.g., the NEST dam database based on 1:100,000 hydrography).
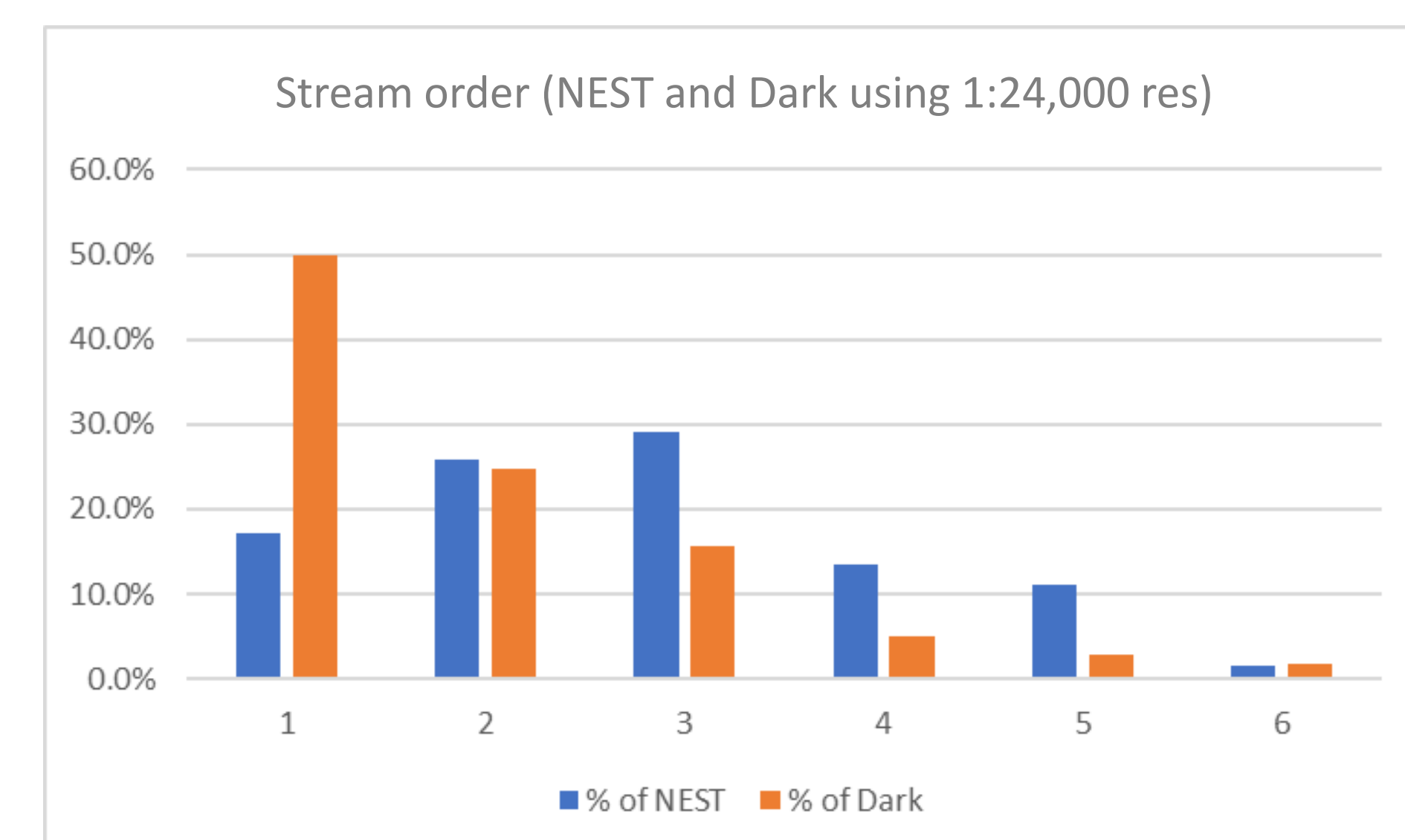
Results

Dark Dams Study Area:
Narraganset Bay Watershed, MA and RI

	MA	RI	Total
State Dams	470	469	939
NEST Dams	315	300	615
% NEST Dams	67%	64%	65%
Dark dams snapped to NHD HR	113	113	226
% Coverage NE + Dark Dams with Stream/ Watershed info	91%	88%	90%

Legend
- NEST dams
- Dark dams
0 5 10 Miles

Comparing Stream Order

Stream order (NEST using 1:100,000 res; Dark using 1:24,000 res)
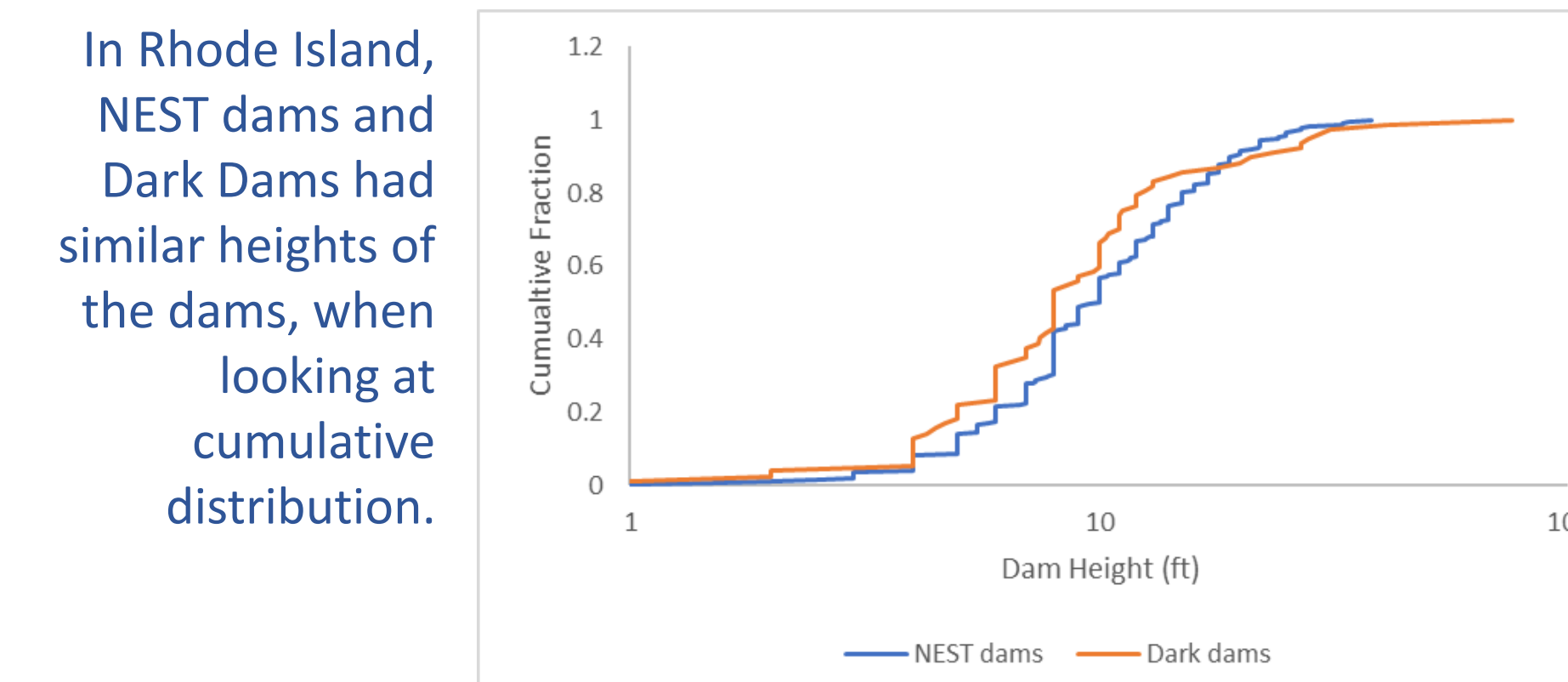

- % of NEST
- % of Dark

Stream order is a product of map scale. Headwater streams have lower order and feed into larger order streams. Above, when comparing the stream order classification between NEST and the Dark Dams, they are similar. However, when we reviewed the NEST dams with the High Resolution maps (below), many of the lower order streams became higher order.

Stream order (NEST and Dark using 1:24,000 res)

- % of NEST
- % of Dark

Comparing Attributes: Height and Risk

In Rhode Island, NEST dams and Dark Dams had similar heights of the dams, when looking at cumulative distribution.

- NEST dams
- Dark dams

Hazard Category	NEST %	Dark %
High	13.7%	7.9%
Significant	35.9%	16.7%
Low	22.9%	52.6%
N/A	27.6%	22.8%

In Massachusetts, Dark Dams tended to be lower risk than the NEST dams.

Watershed Size and N removal potential

Distribution of Watershed Areas for NEST dams and dark dams

Dark dams < 10 km²
NEST dams < 10 km²

Distribution of Pond areas for NEST dams and dark dams

- NEST Pond areas
- DARK pond areas
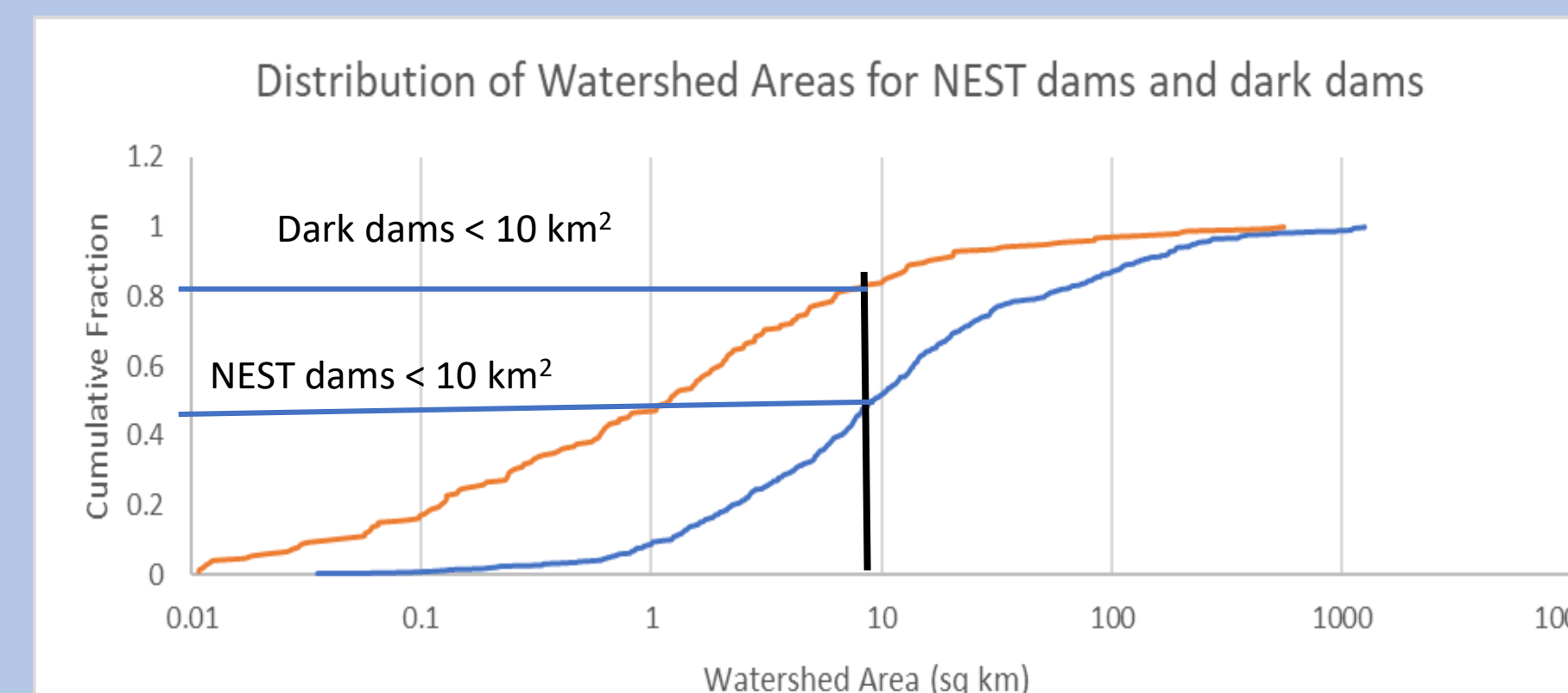
Dark Dams had a greater proportion of small watersheds than the NEST dams (Top). Dark dams also had a greater proportion of small reservoirs than the NEST dams (bottom).

Medium Loading Watersheds (4-8 kg N/ha/yr)

N removal (%)

High Loading Watersheds (>8 kg N/ha/yr)

N removal (%)

- NEST dams
- Dark dams
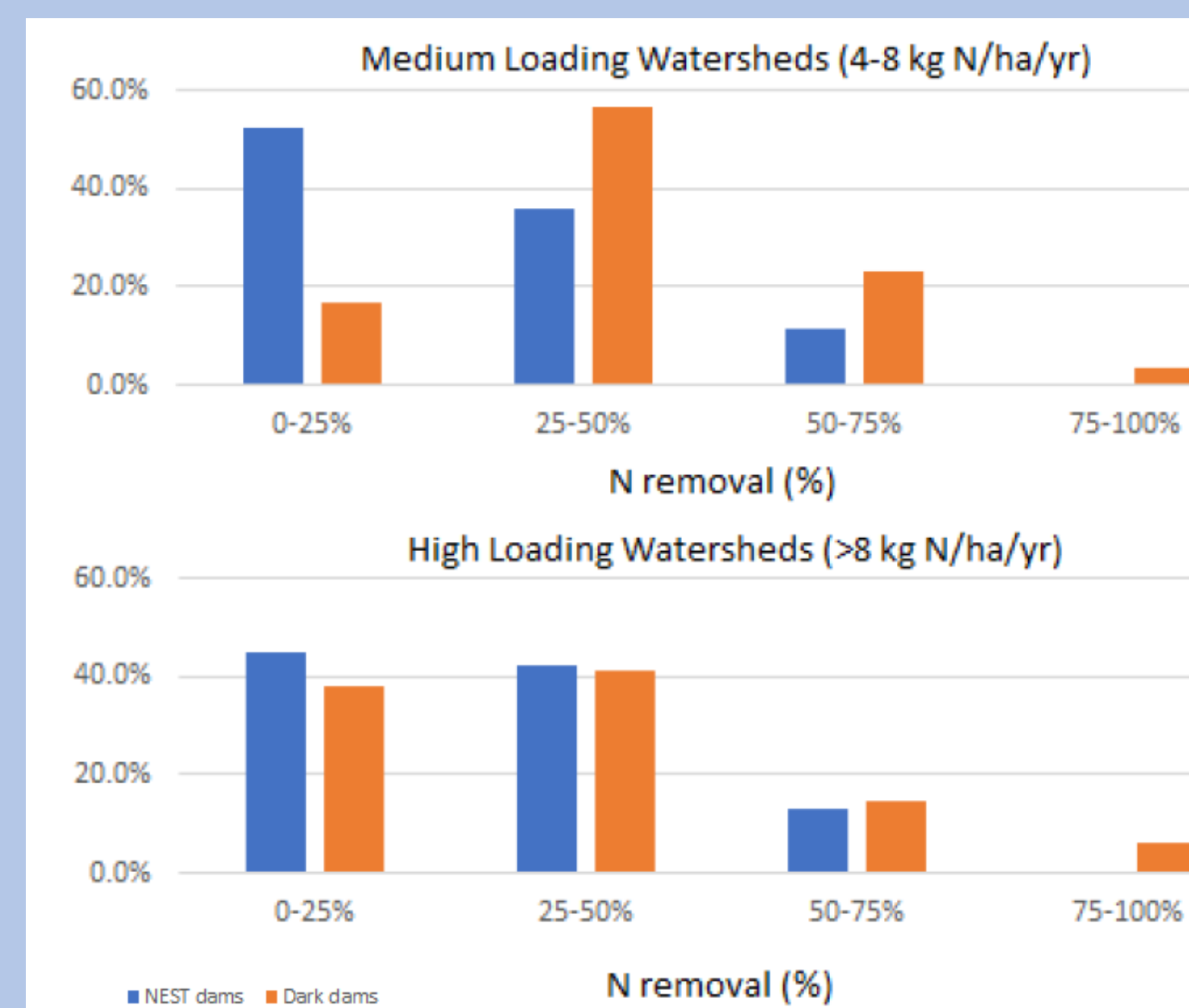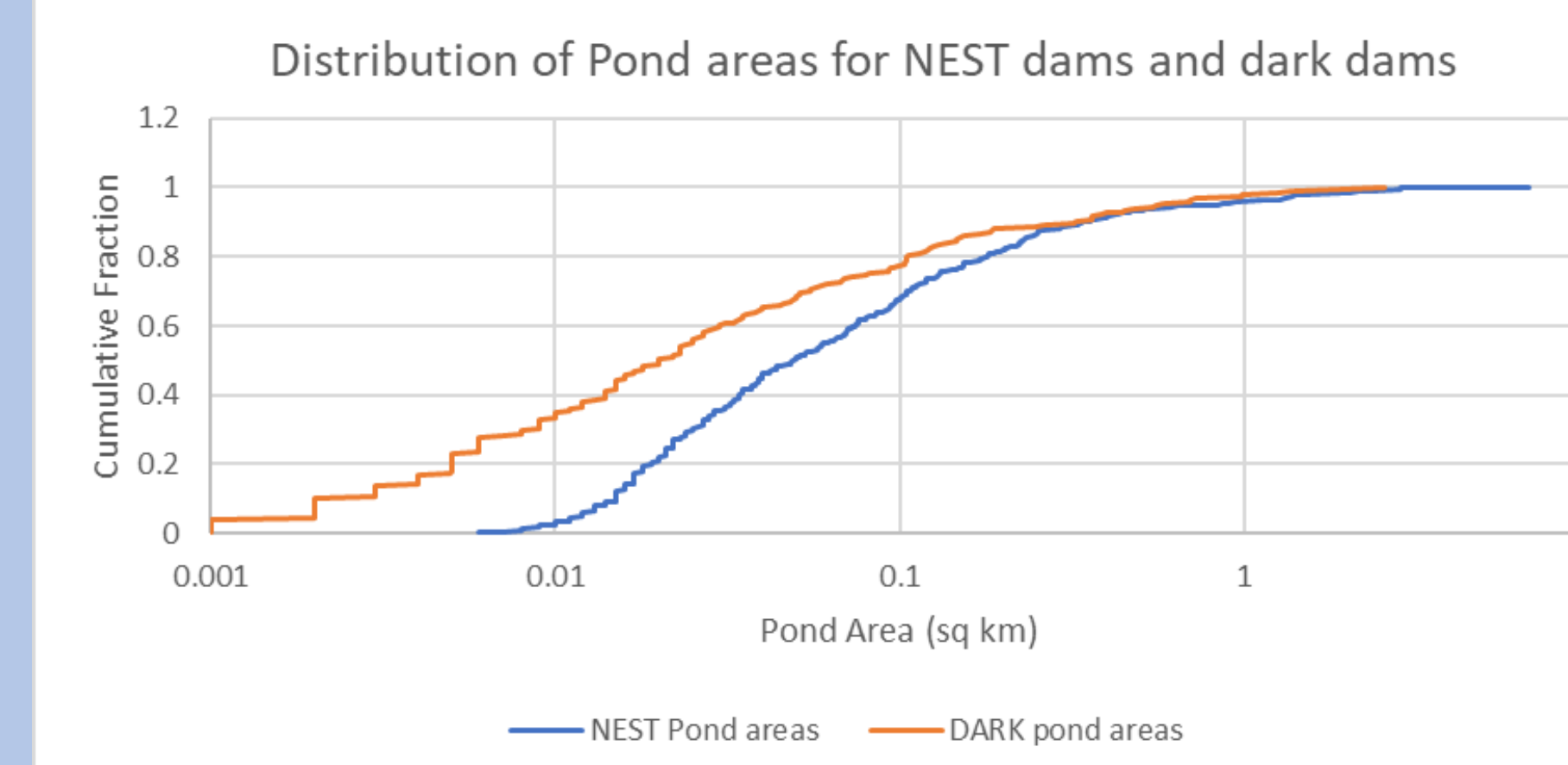
The nitrate-N removal potential of a reservoir is based on the ratio of watershed area to reservoir area. Therefore, Dark Dams have high potential for nitrate-N removal in their reservoirs.

Methodology

- Study Area: Narragansett Bay Watershed, includes 939 dams per state databases
- Dark Dams were identified after eliminating NEST dams from MA and RI databases.
- The NEST database process was replicated for the Dark Dams and NHD HR.
  - "Snap" dams to flowlines
  - Identify associated reservoirs with "Near" function
  - Delineate watersheds
  - Use NLCD 2011 to obtain land cover data for the watershed.
- Nitrogen removal analysis performed according to method in Gold et al.[2]

Sample reservoir above a dam (red dot) along flow lines. High resolution digital orthophotos used to confirm the existence of a dam which was then snapped to the river.

Summary

- NHD HR expanded a subset of the NEST dam database and captured most dams in the RI and MA state databases.
- Dark Dams and NEST dams had similar heights in RI
- Dark Dams had lower hazard classes than NEST dams in MA
- Some inconsistency (e.g., stream order) found for NEST dams based on low vs. high resolution hydrography
- Watershed and reservoirs of Dark Dams tended to be smaller, with potential for higher N removal

Next steps?

- Would multi-jurisdictional studies benefit from Dark Dam data?
- Include NHD HR data in NEST database?
- Would Nature Conservancy be interested in Dark Dam data for connectivity?