REGIONAL COASTAL ASSESMENT PROGRAM

(Formally known as the Coastal Bend Bays Project)

A Proactive Approach in Coastal Monitoring for South Texas

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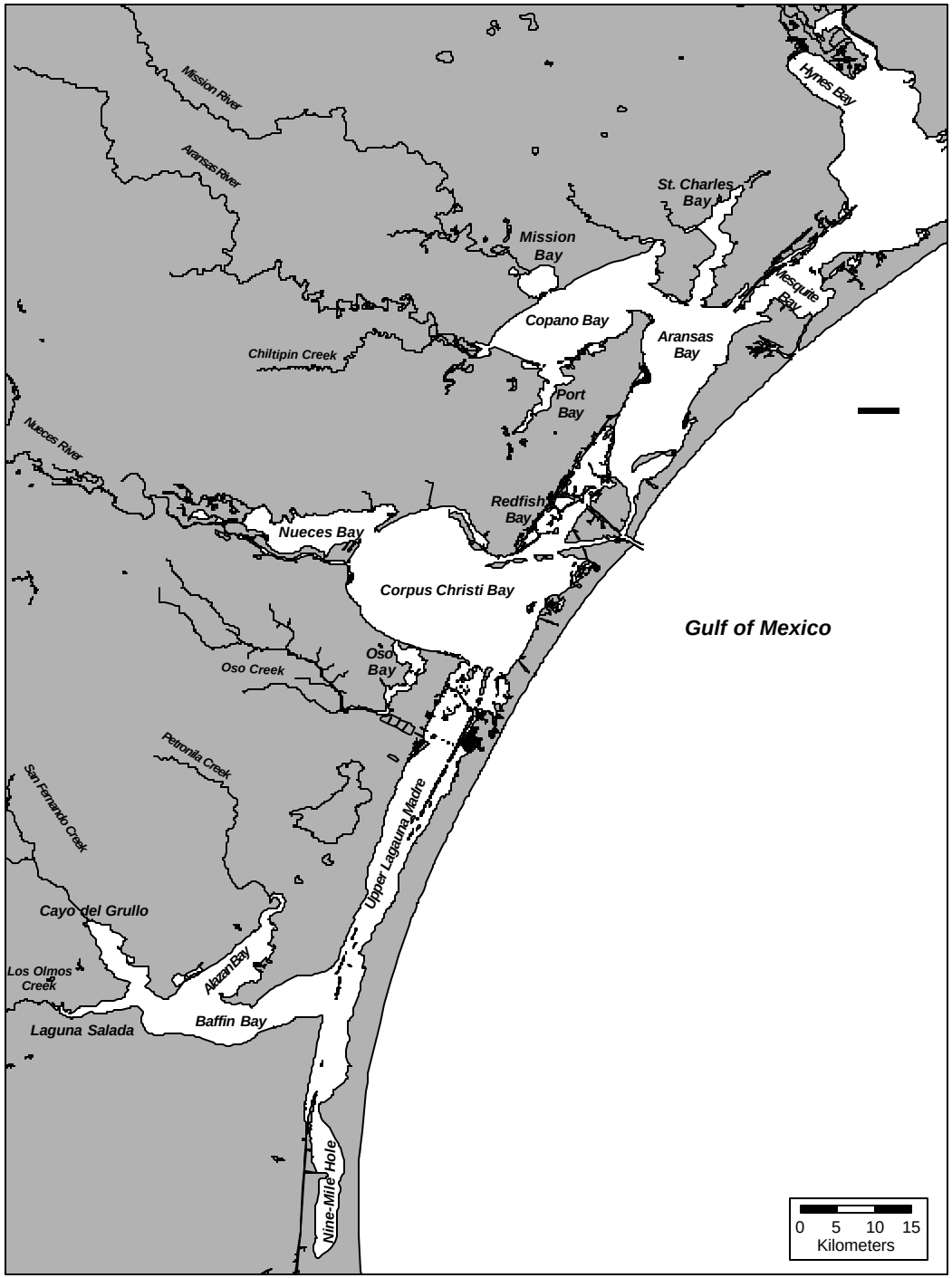
- Port Industries of Corpus Christi
- Texas Commission on Environmental Quality
  - Houston Analytical Laboratory (Year 1)
- Texas General Land Office
  - Coastal Coordination Council - Coastal Management Program
- National Oceanic and Atmospheric Administration
  - Coastal Zone Management Program
- U.S. Environmental Protection Agency
  - Region 6
  - National Health and Environmental Effects Research Laboratory - Gulf Ecology Division

CBBEP Region

- 3 of the 7 major Texas systems
  - Mission - Aransas, Nueces, and Upper Laguna Madre
  - 600 square miles
  - ~ 30% of the Texas Coastline
- Connected yet biogeographically distinct
- Salinity increases north to south
  - Laguna Madre one of a few hypersaline lagoons in the world
- Semi-arid, sub-tropical climate
  - Average rainfall 25 to 38 inches
  - highly variable
  - Tropical Storms / Hurricanes



BACKGROUND AND PROJECT JUSTIFICATION

- **CBBEP region historically under sampled for water quality parameters**
  - **Decline in temporally and spatially intense monitoring since the mid-1970s**
  - **Sufficient monitoring of Copano and Aransas Bays is lacking**
  - **No consistent historical monitoring of specific parameters within the expansive Coastal Bend Bay System**

BACKGROUND AND PROJECT JUSTIFICATION

- **Historical data raised numerous Water Quality concerns within the CBBEP System**
  - **Chlorophyll-a, DO, salinity (lack of freshwater inflows)**
  - **Priority pollutant metals including cadmium, copper, chromium, lead, mercury, nickel, and zinc**
  - **Portions of CBBEP Region placed on Texas 303 (d) list of impaired waters for elevated zinc in oyster tissue. TMDL currently being conducted**
    - **Most listed for fecal coliforms (Oso Bay and ULM for DO)**
    - **<u>Nearly</u> listed for copper (d) (Station 13407 – Marker 62 in CC Bay)**
- **Stakeholder Concern (TMDL)**
- **Proactive Approach** **(Bottom-Up rather than Top-Down)**

PROJECT OBJECTIVES

- **Conduct an intensive, targeted monitoring study to adequately characterize CBBEP Water Quality conditions:**
  - **Produce scientifically sound Water Quality data**
    - **QAPP (but of course)**
    - **"Ultra - Clean" Sampling and Laboratory Techniques**
    - **Utilizing Improved Analysis Methods**
  - **Produce sufficient data to describe spatial and temporal Water Quality trends in the CBBEP region**
    - **Superior quality compared to historical monitoring data**
    - **Address areas and parameters of historic concern**
  - **Produce a extensive, reliable, and powerful data set**
    - **Solid basis for future management decisions**
    - **Accurate data that allows for precise localization of anthropogenic influences**

RCAP 2000 - 2001

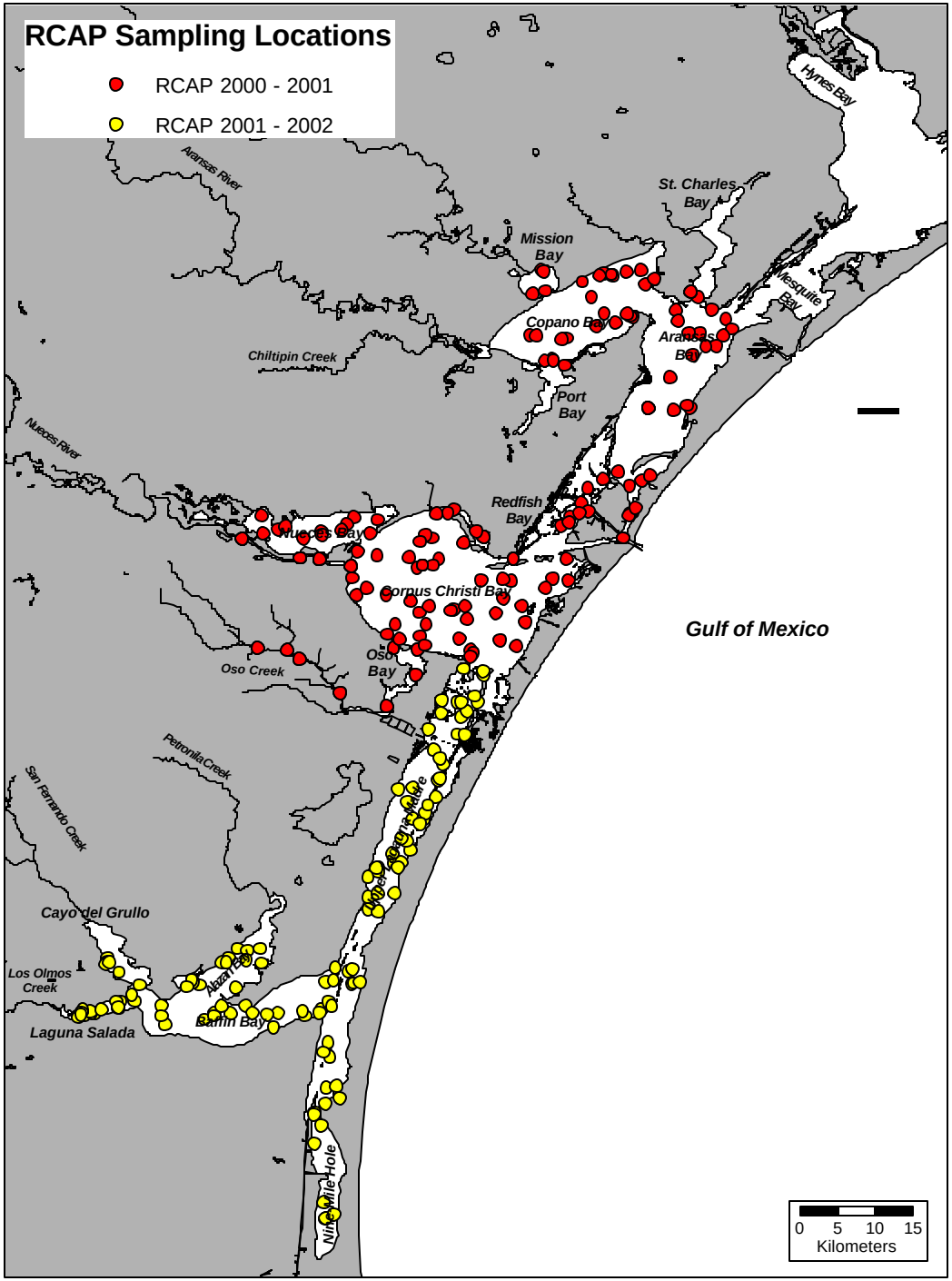
APRIL 2000 THROUGH MAY 2001

- 30 "EMAP" Stations (n = 120)
  - One Per Hexagon Per Quarter
  - Field, RC, TM, and Bio
  - Sediment for 1 Quarter
- 6 "Targeted" Stations (n = 36)
  - Bi-monthly sampling
  - Field, RC and TM
  - TCEQ Established Stations
- 4 Inner Harbor Stations (n = 16)
  - Quarterly Sampling
  - Field, RC, TM
  - TCEQ Established Stations
- 4 Oso Creek and 4 Oso Bay (n = 16)
  - First 2 Quarters
  - Field, RC, and TM
  - TCEQ Established Stations

RCAP 2000 - 2001

JULY 2001 THROUGH MAY 2002

- 31 "EMAP" Stations (n = 124)
  - One Per Hexagon Per Quarter
  - Field, RC, TM, and Bio
  - Sediment for 1 Quarter



Monitoring Parameters

Field Measurements

Routine Water Chemistry

Sediments

Total & Dissolved Metals

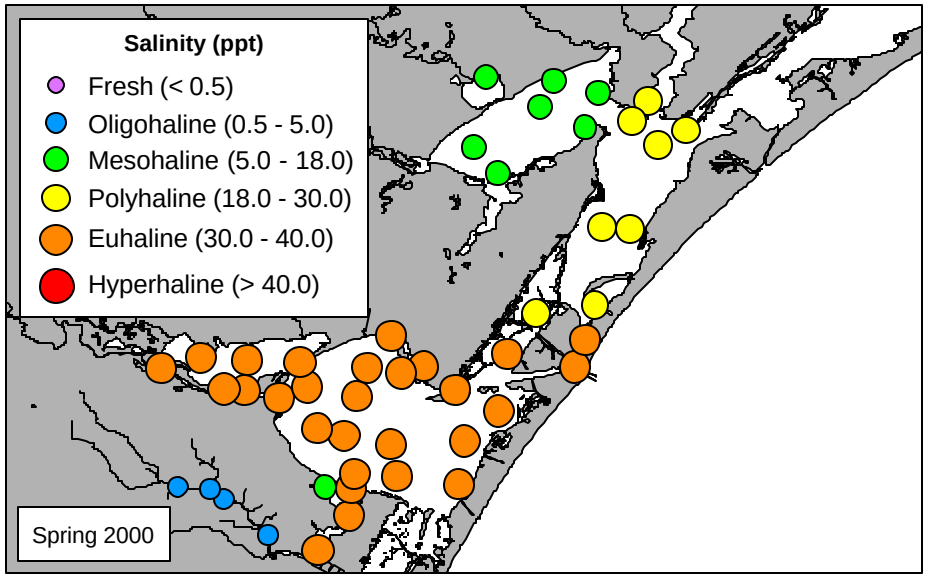
Biological

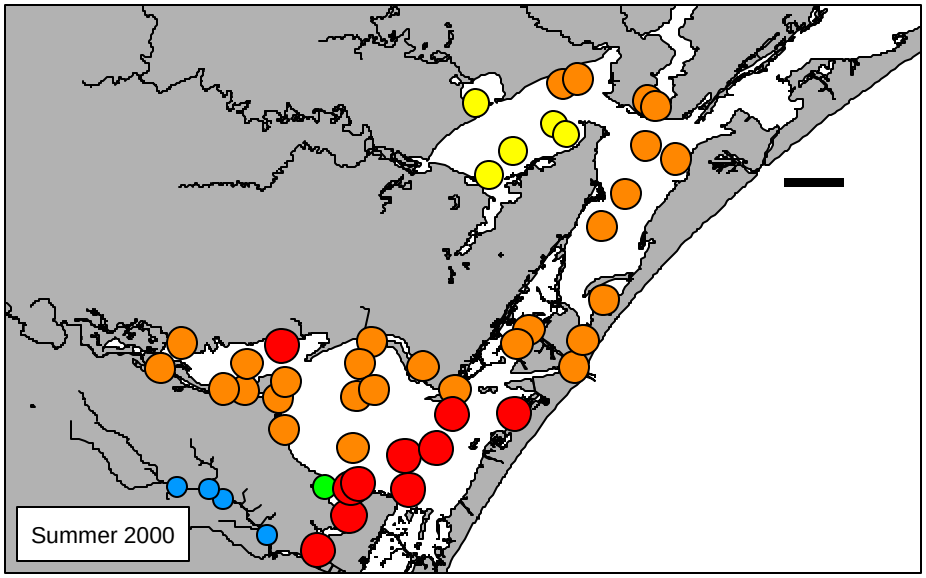
Field Measurements

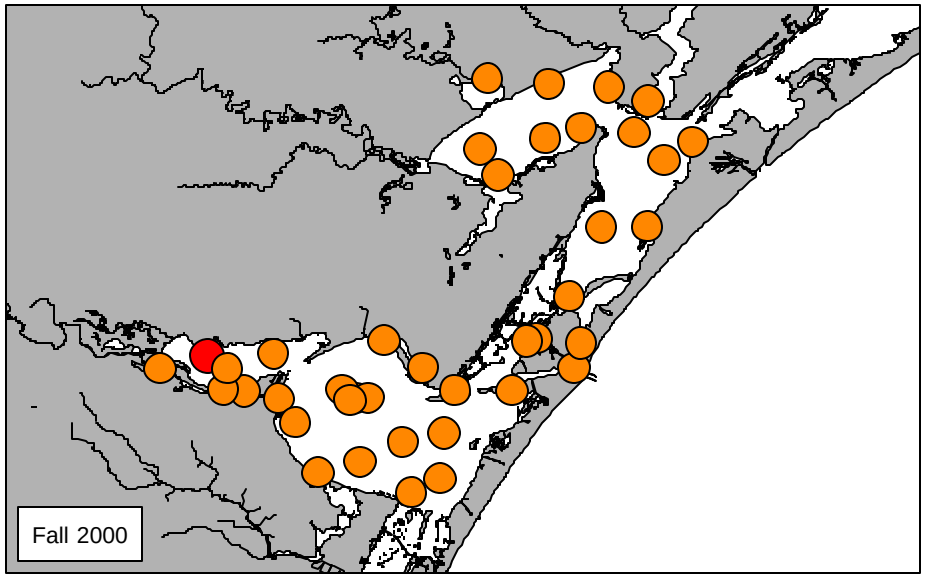
- **Field Data**
  - Weather
  - Wind Conditions
  - Sea State
  - Water Clarity

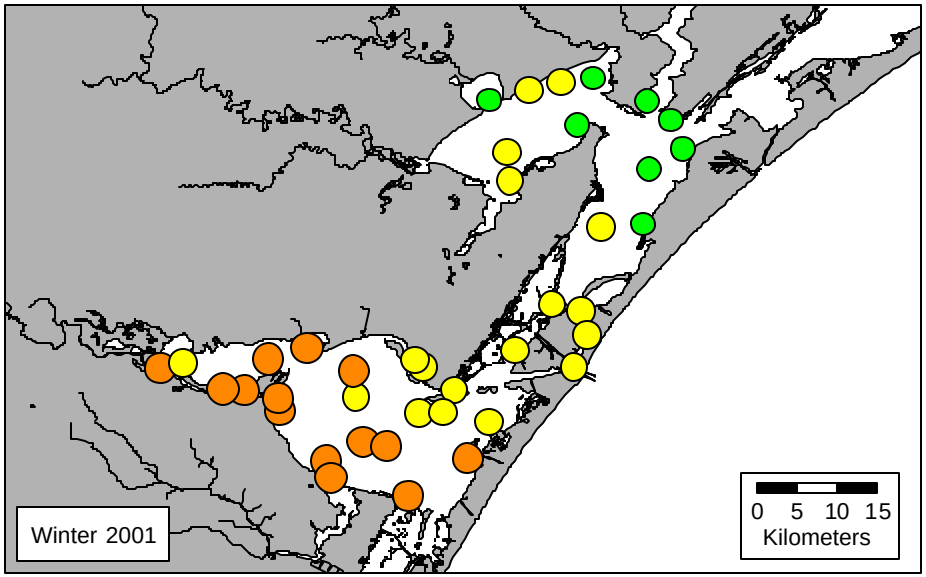
- **Hydrolab**
  - Water Temperature
  - Dissolved Oxygen
  - Conductivity / Salinity
  - pH

Salinity

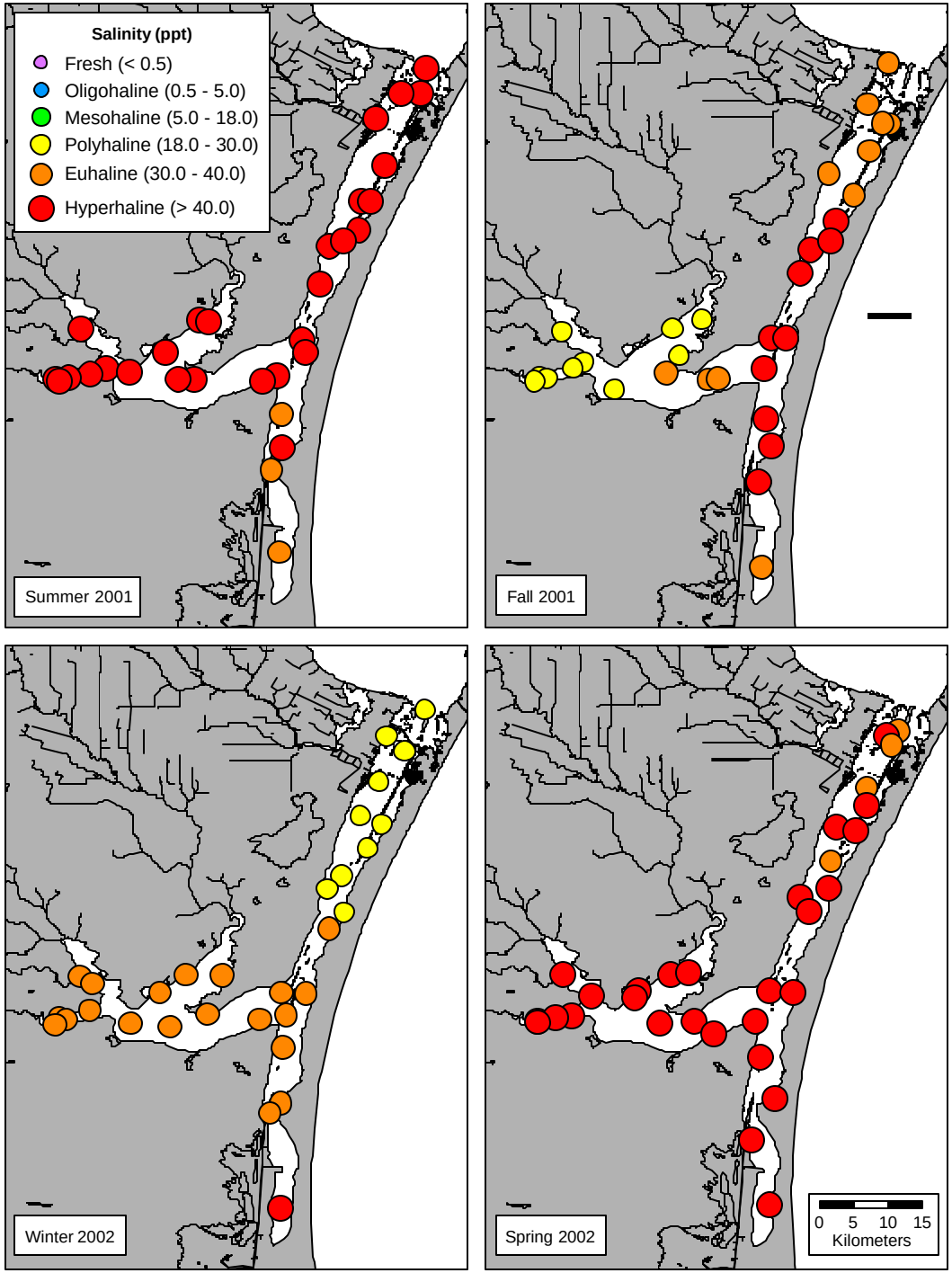

Salinity (ppt)
Fresh (< 0.5)
Oligohaline (0.5 - 5.0)
Mesohaline (5.0 - 18.0)
Polyhaline (18.0 - 30.0)
Euhaline (30.0 - 40.0)
Hyperhaline (> 40.0)
Spring 2000


Summer 2000


Fall 2000


Winter 2001
0 5 10 15
Kilometers

Salinity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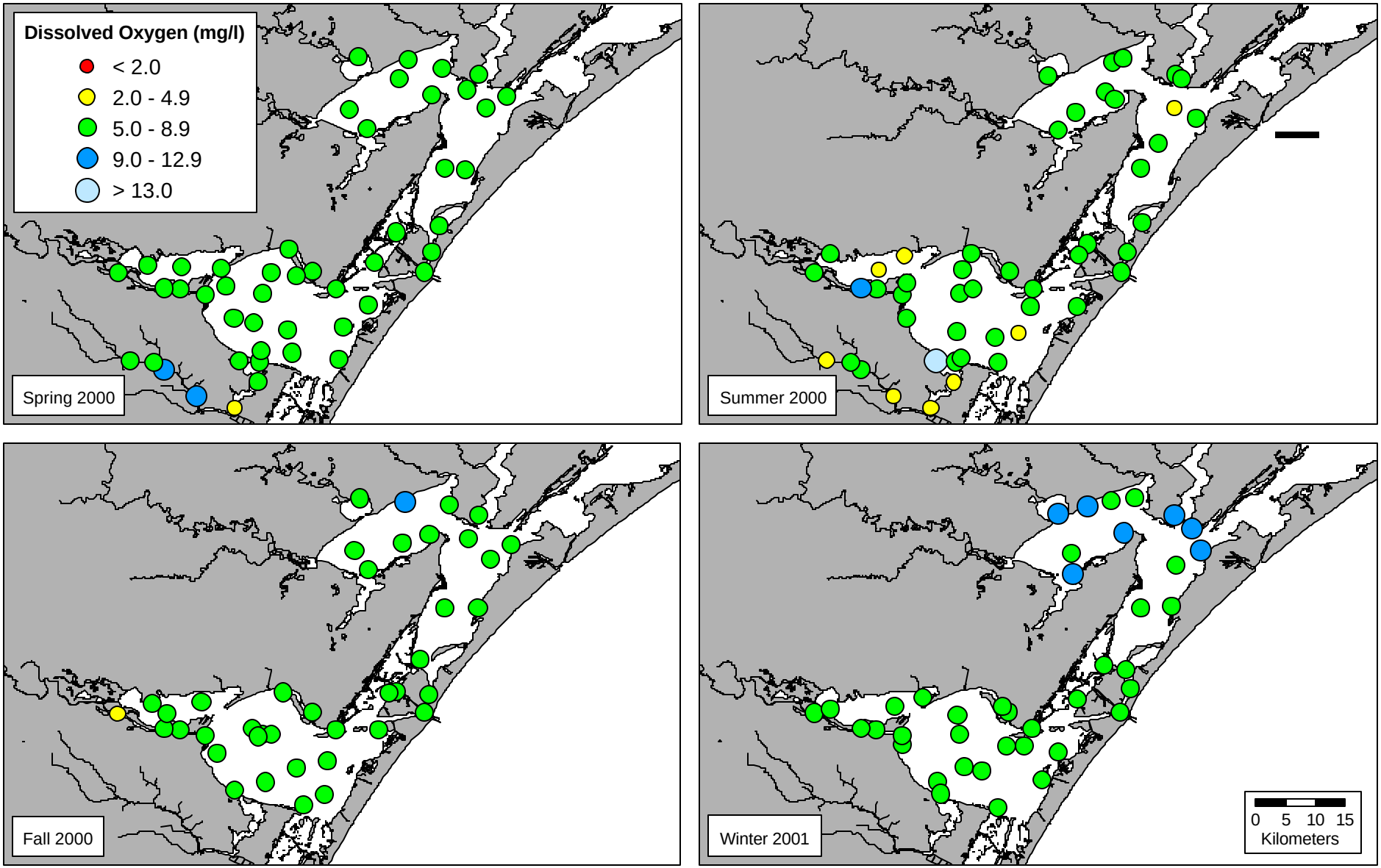
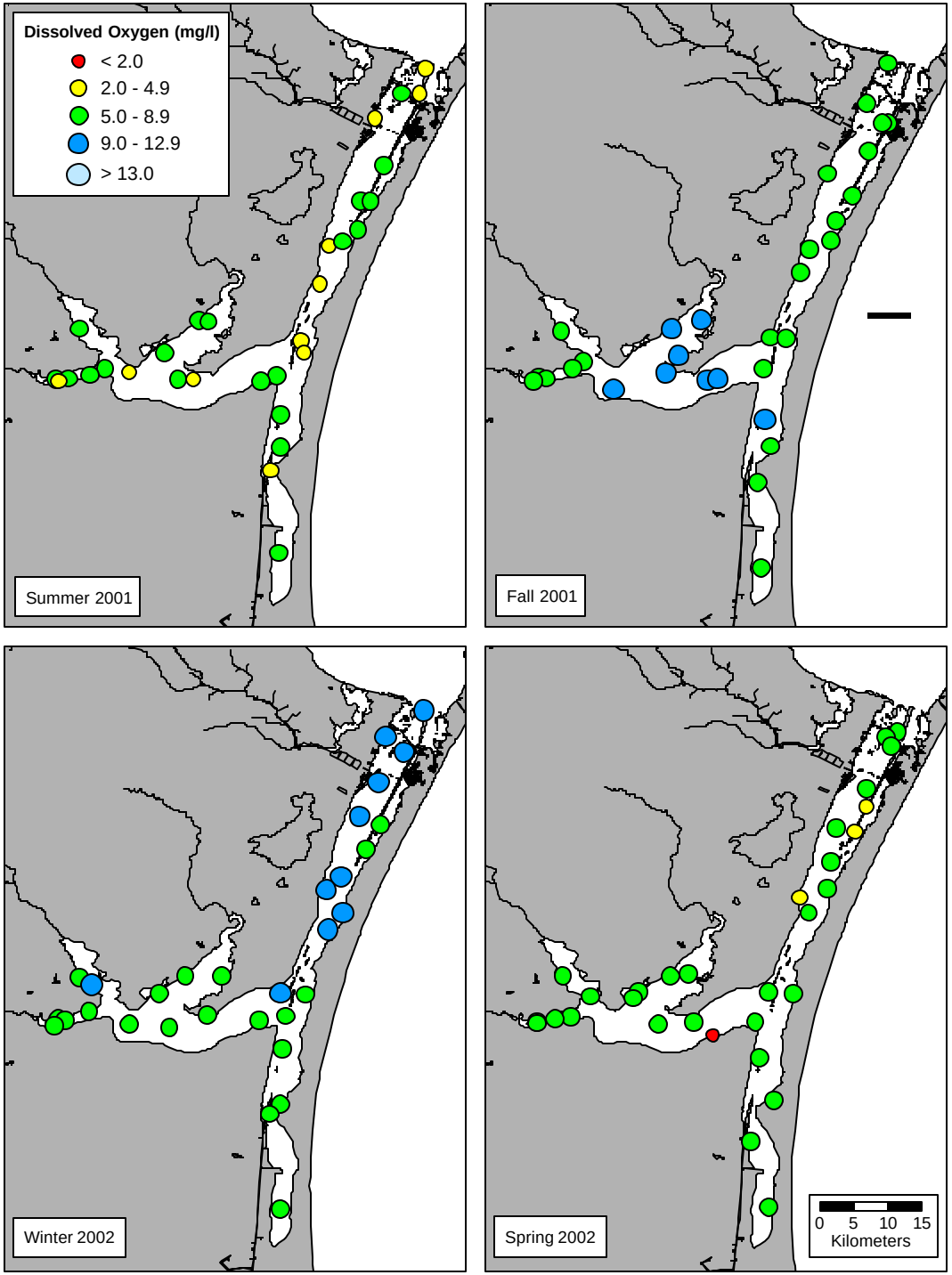
Euhaline (30.0 - 40.0)
Hyperhaline (> 40.0)
Summer 2001
Fall 2001
Winter 2002
Spring 2002
0 5 10 15
Kilometers

Dissolved Oxygen



Dissolved Oxygen



Routine Water Chemistry

TCEQ CONVENTIONALS

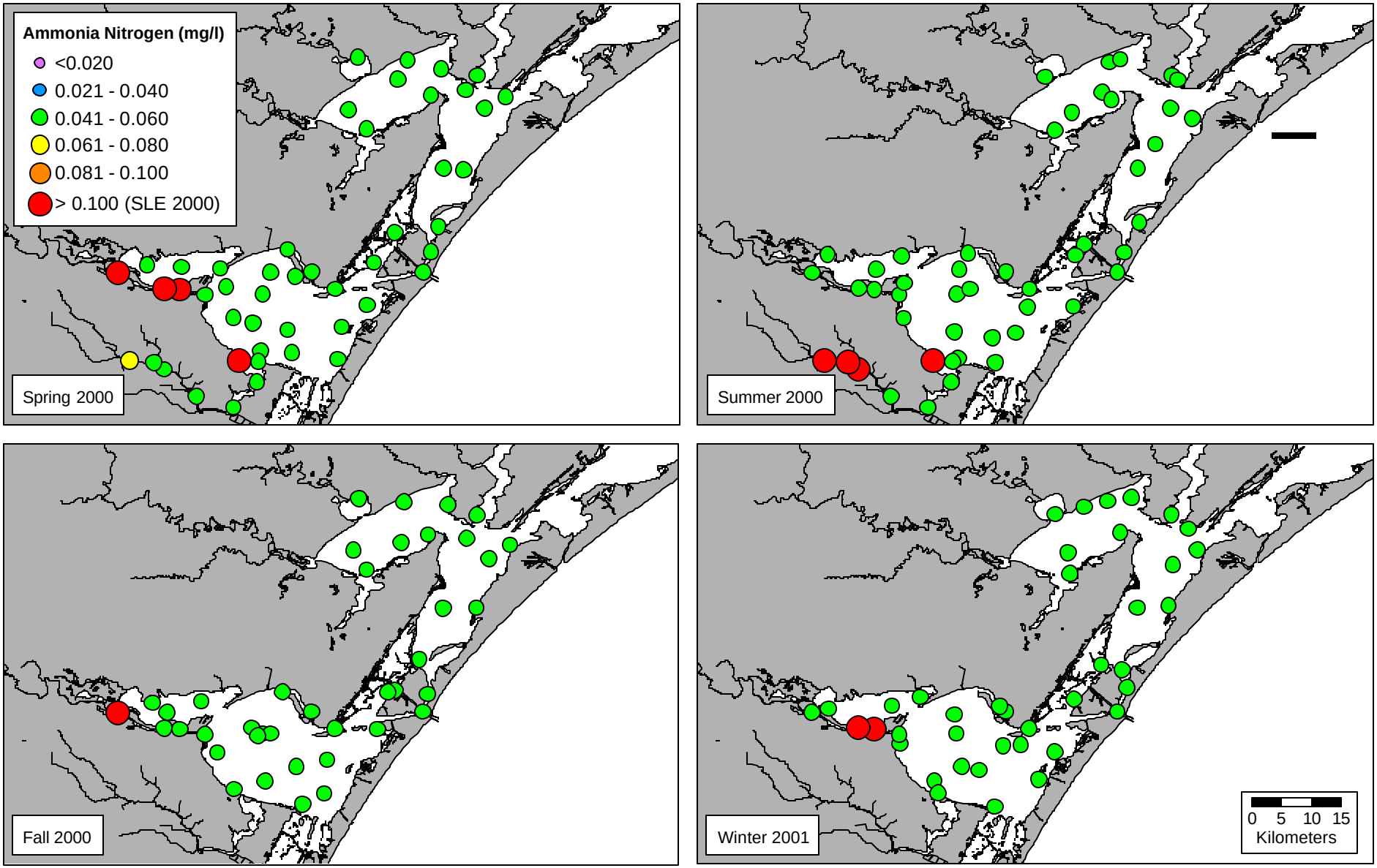
- Alkalinity
- Ammonia - Nitrogen
- Nitrate + Nitrite - Nitrogen
- Total Kjeldahl Nitrogen
- Chloride
- Sulfate
- Total Organic Carbon
- Total Dissolved Solids
- Total Suspended Solids
- Volatile Suspended Solids
- Total Phosphorus
- Ortho – phosphorous
- Chlorophyll – *a*
- Pheophytin – *a*

✓ Water quality criteria for nutrients and chlorophyll *a* in water have not been developed…….yet.

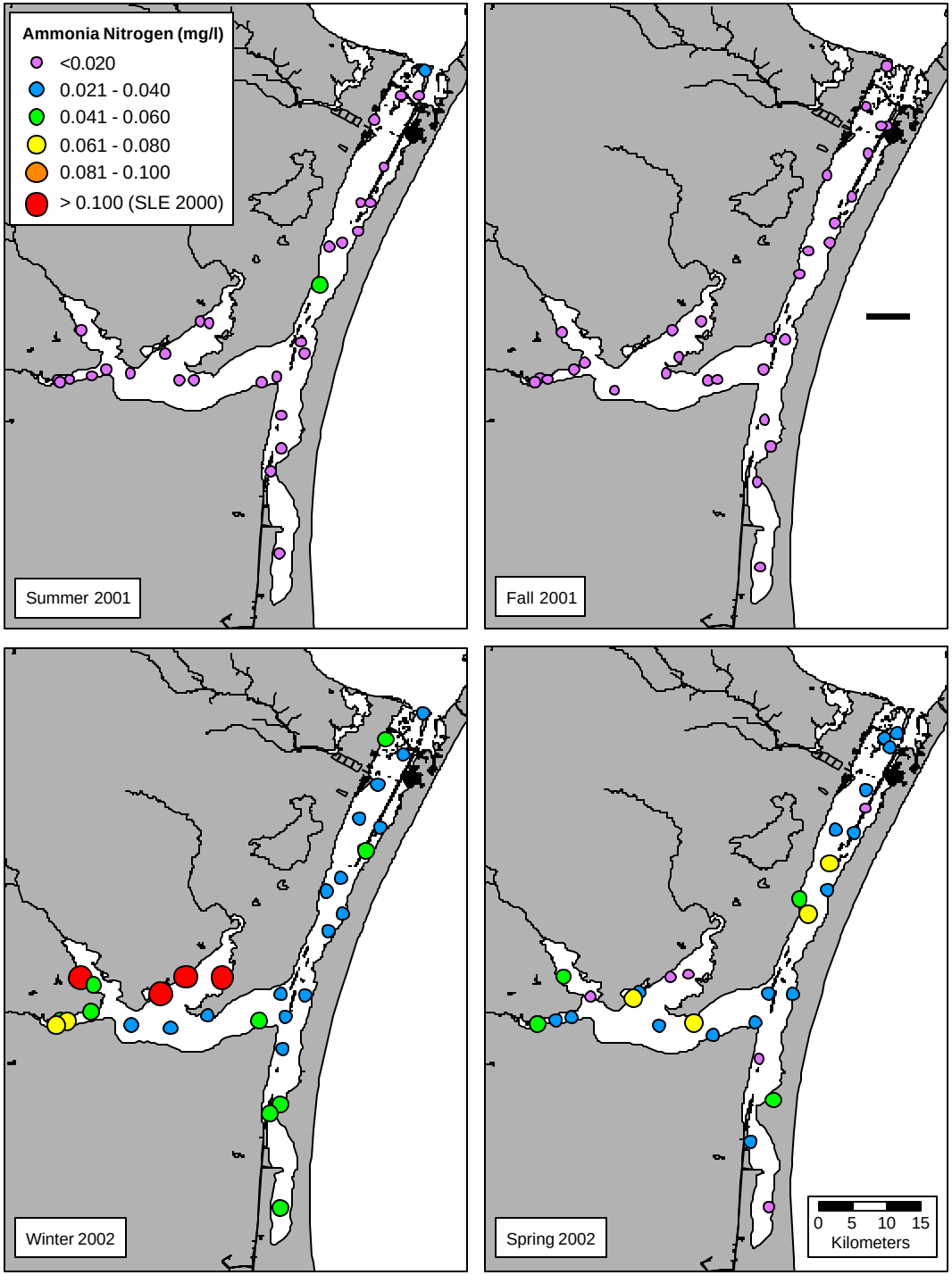
✓ Screening levels used by TCEQ to identify secondary concerns.

✓ Currently based on a 10 – sample minimum.

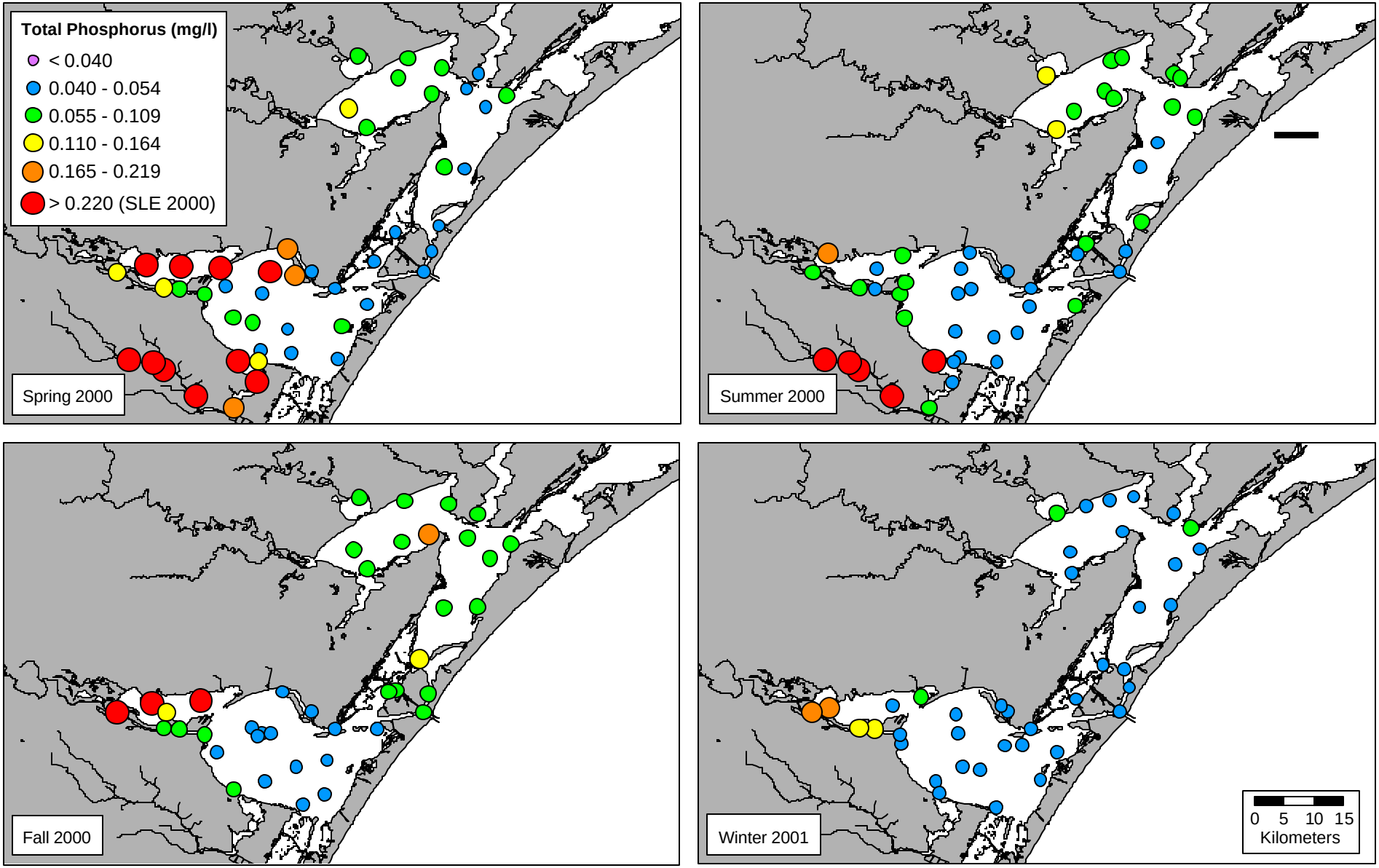
Ammonia Nitrogen



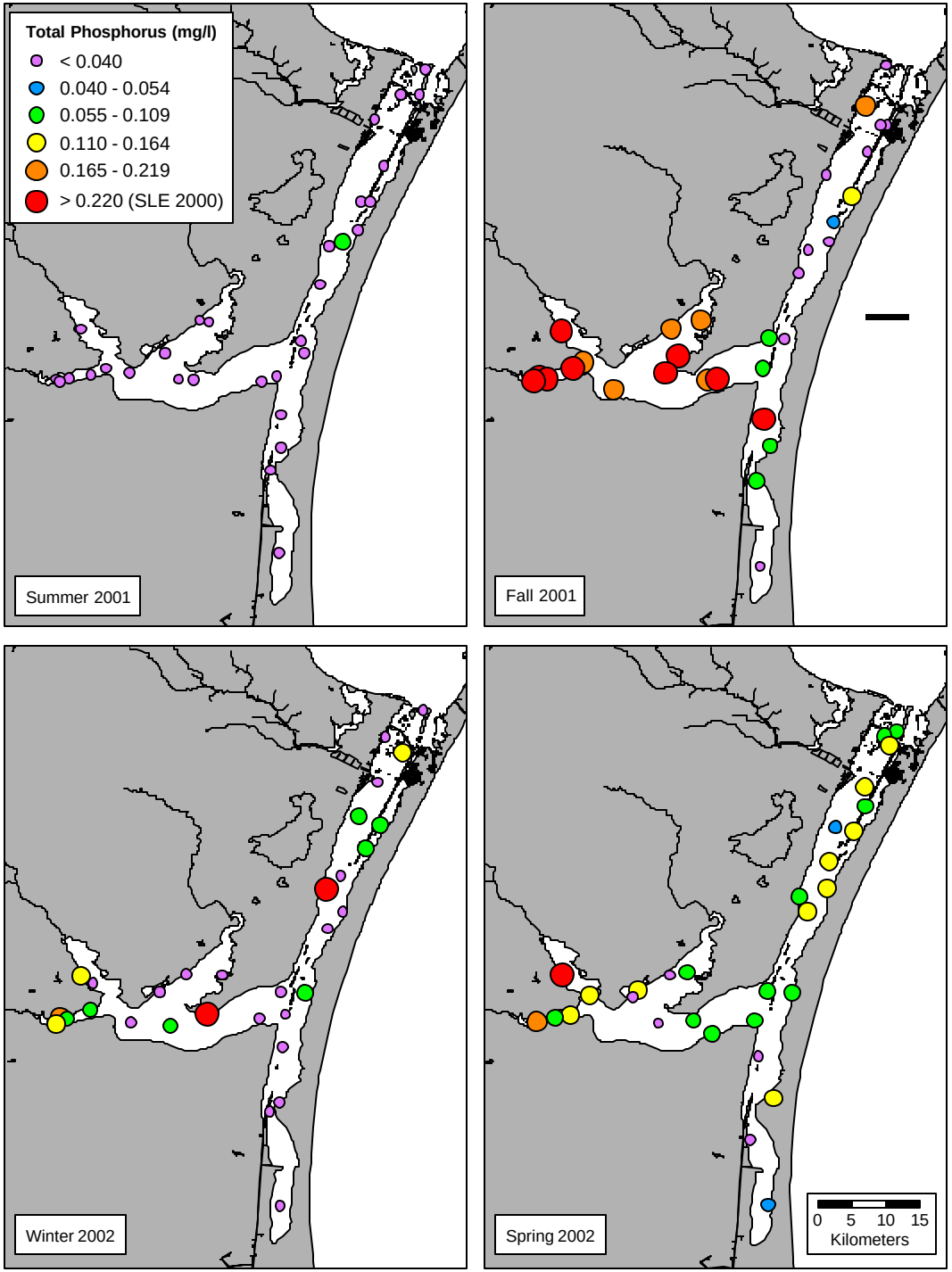
Ammonia Nitrogen



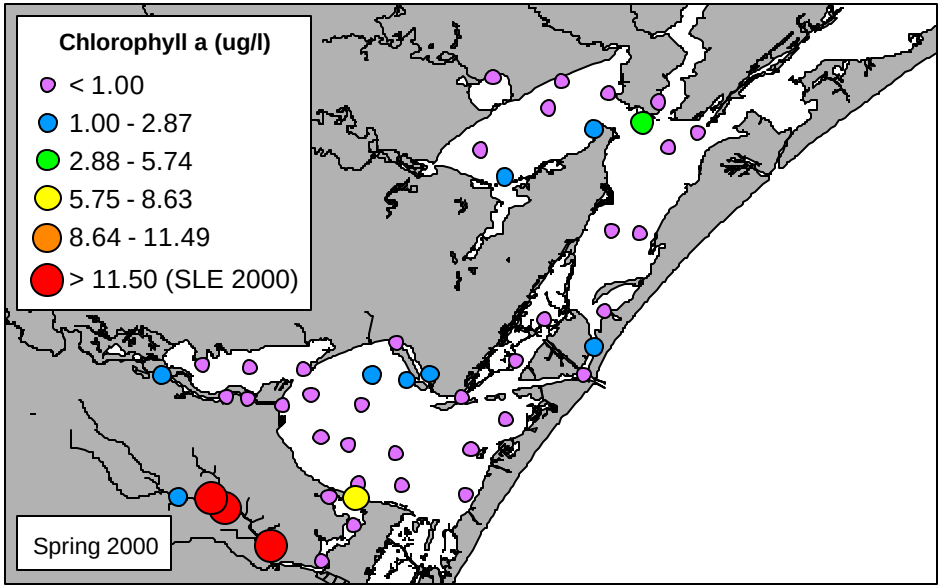
Total Phosphorus

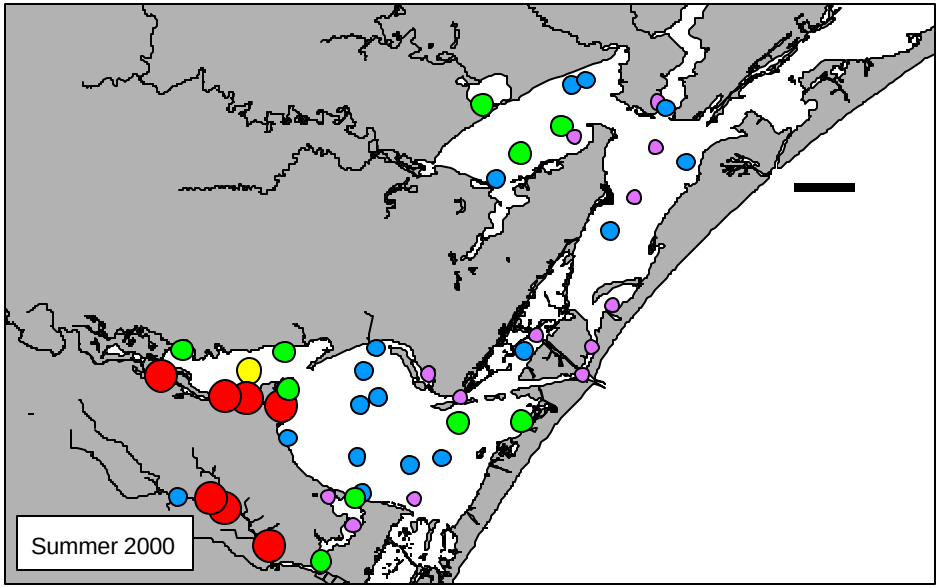


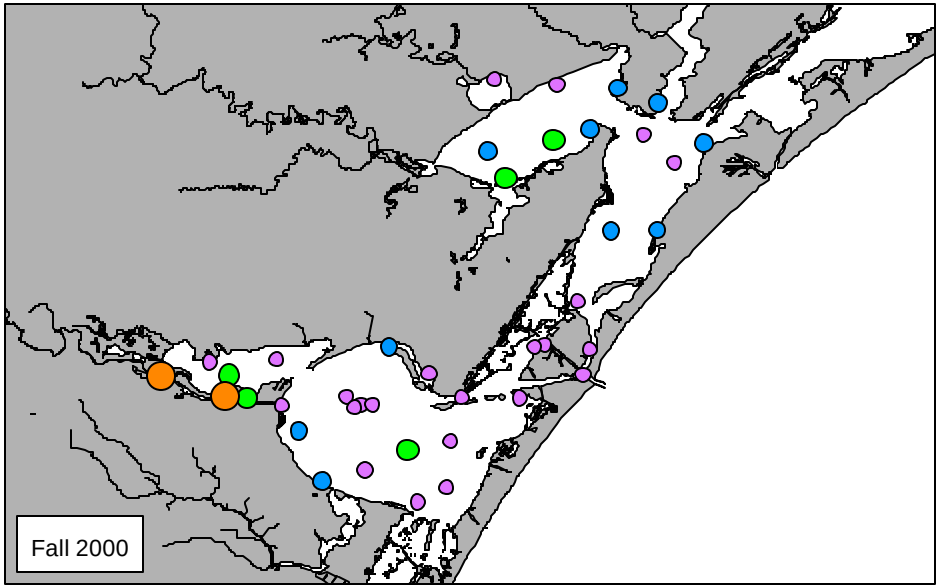
Total Phosphorus

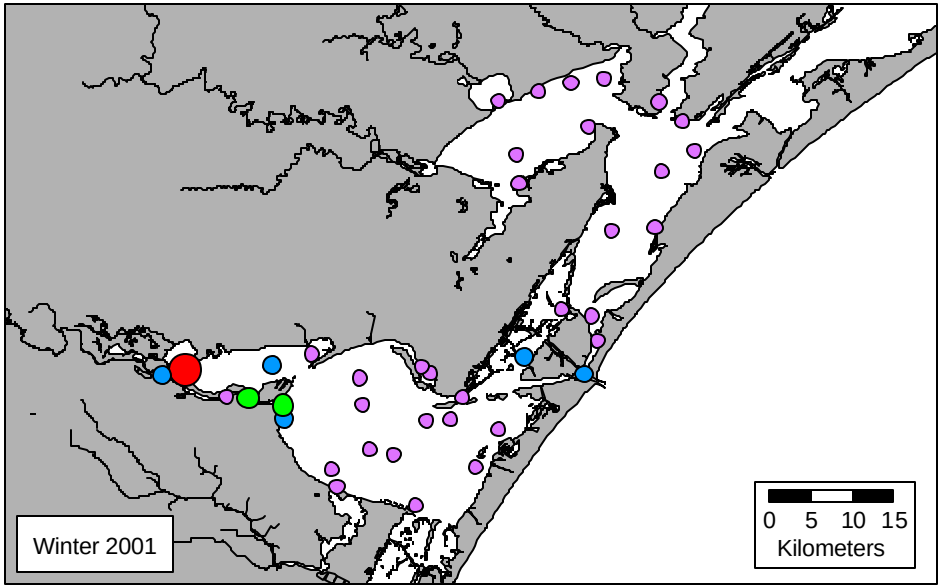


Chlorophyll *a*

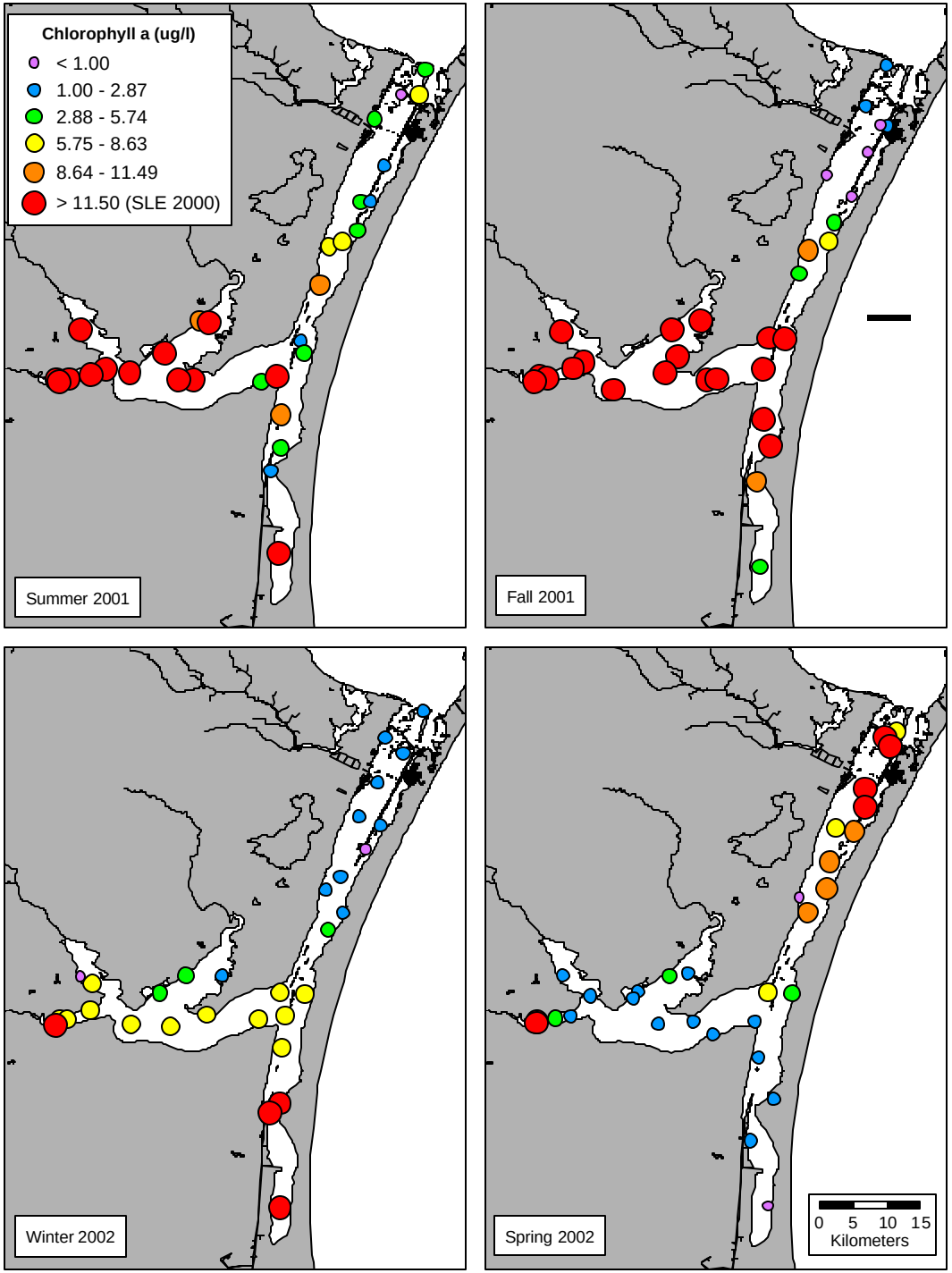








Chlorophyll *a*



Sediments

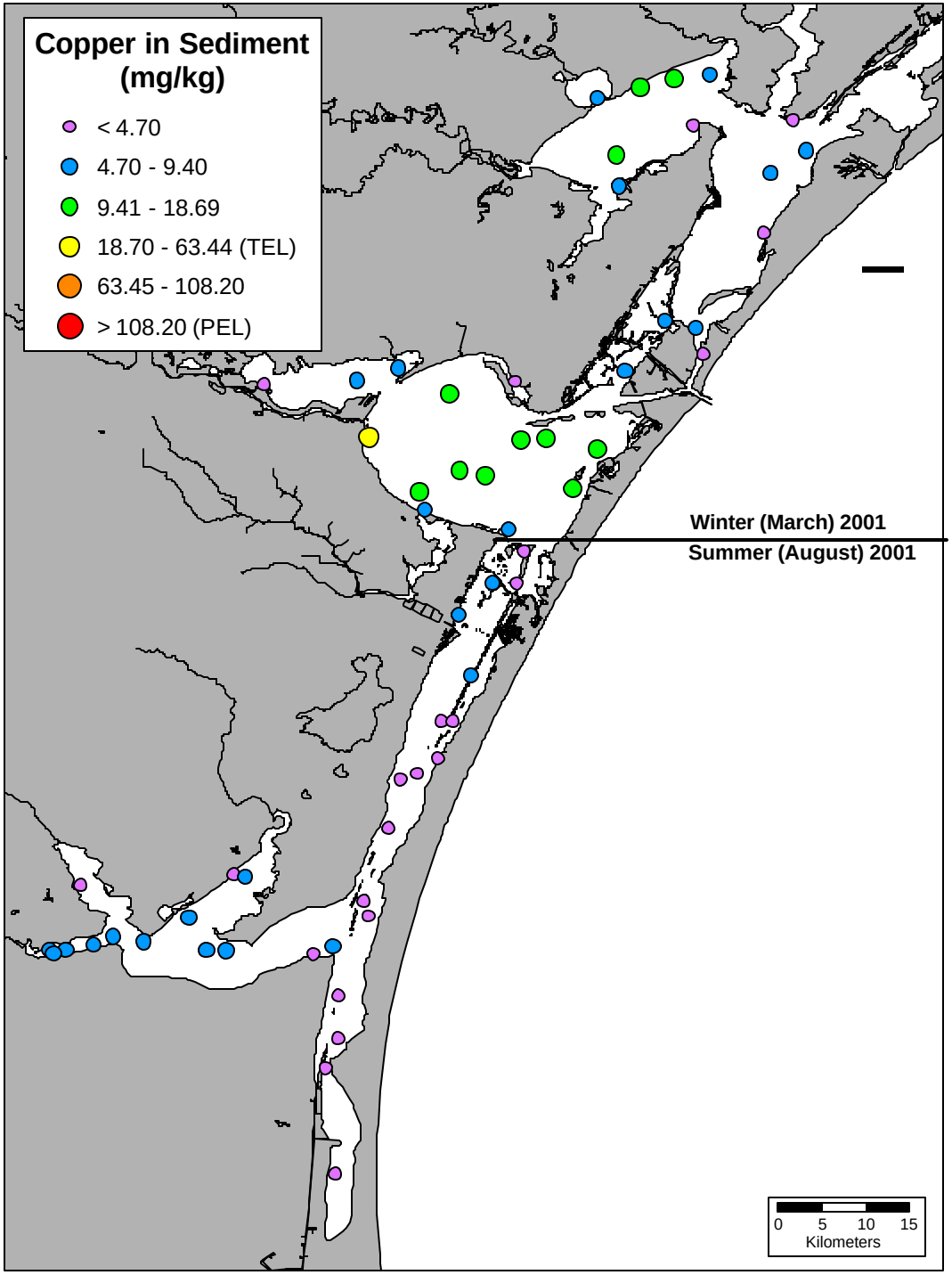
Trace Metals

Total Organic Carbon

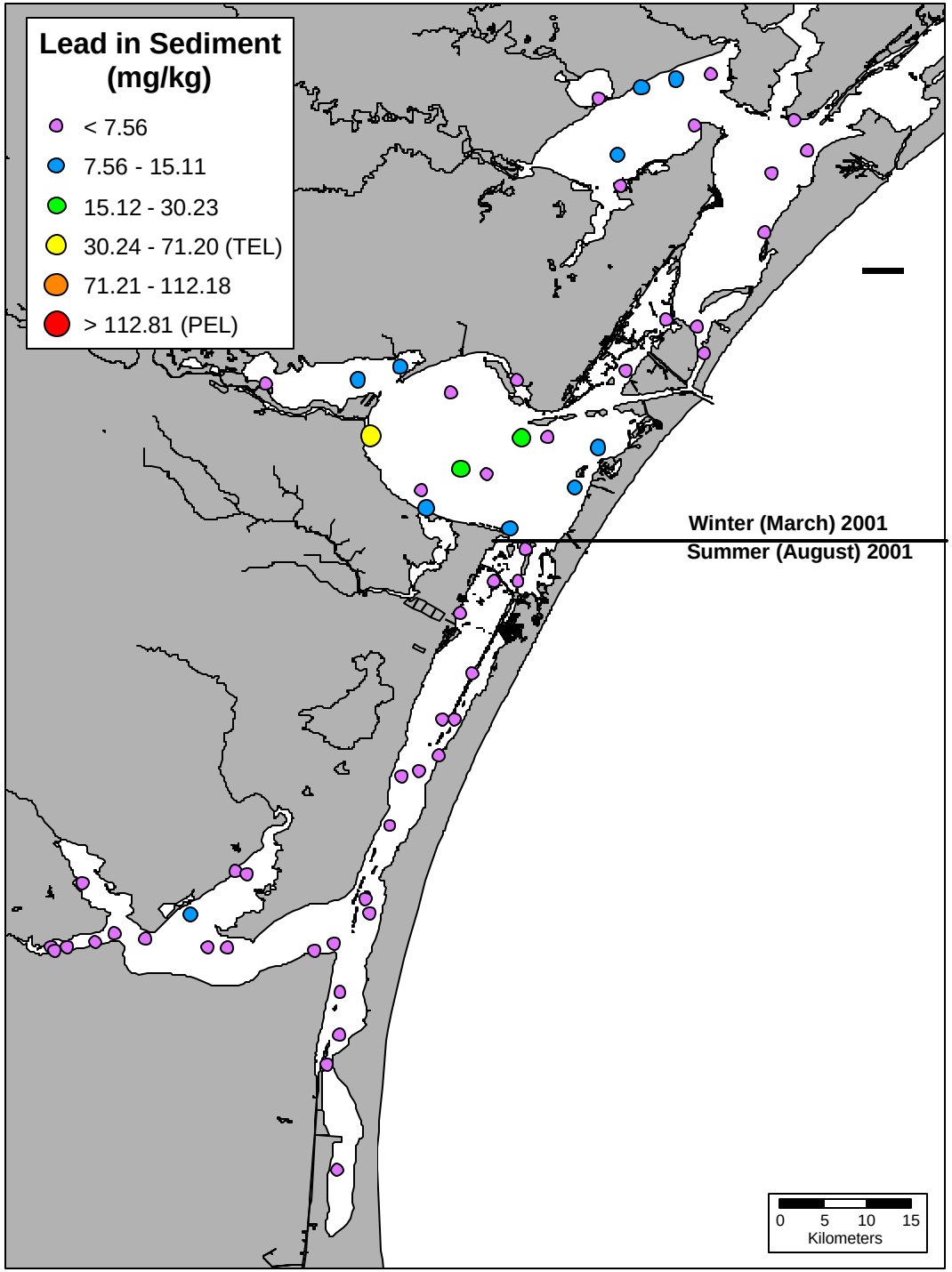
Sediment Grain Size

- Sediment criteria developed by the EPA for only a few parameters, but not adopted.
- Screening levels (PEL's and 85th percentile) used by TCEQ to identify secondary concerns.
- Currently based on a 10 – sample minimum.

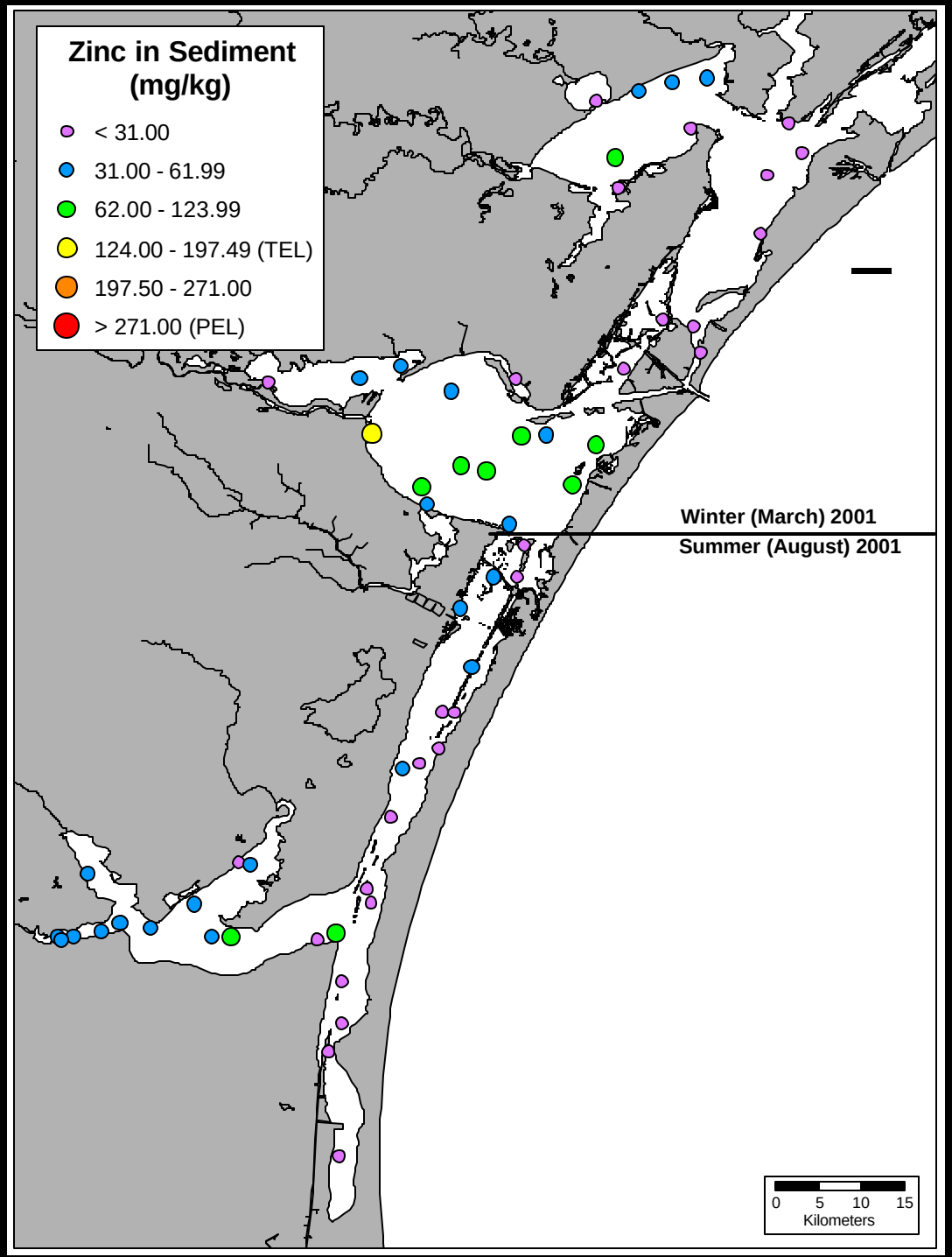
Copper


Copper in Sediment (mg/kg)
< 4.70
4.70 - 9.40
9.41 - 18.69
18.70 - 63.44 (TEL)
63.45 - 108.20
> 108.20 (PEL)
Winter (March) 2001
Summer (August) 2001
0 5 10 15
Kilometers

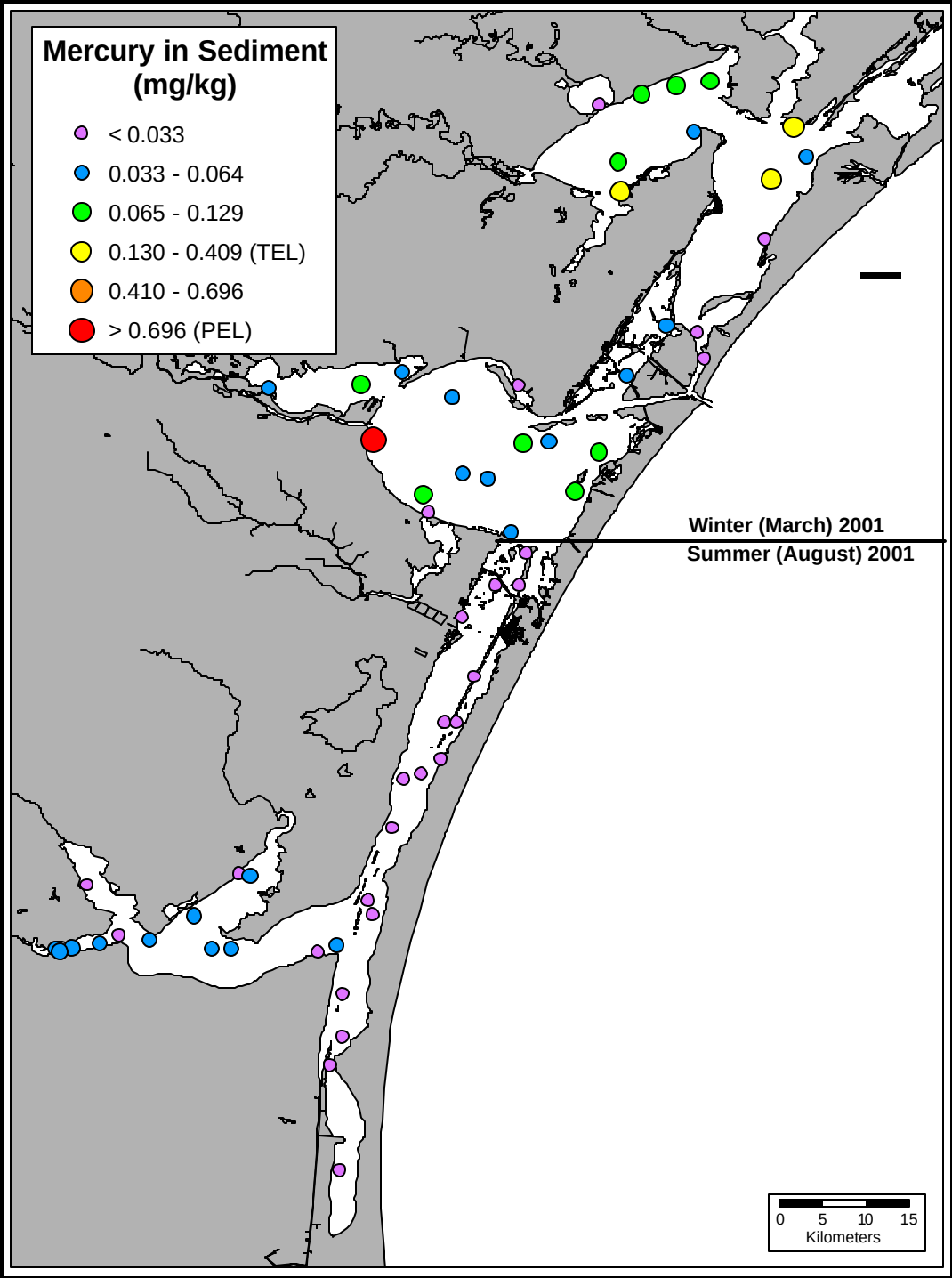
Lead


Lead in Sediment (mg/kg)
< 7.56
7.56 - 15.11
15.12 - 30.23
30.24 - 71.20 (TEL)
71.21 - 112.18
> 112.81 (PEL)
Winter (March) 2001
Summer (August) 2001
0 5 10 15
Kilometers

Zinc


Zinc in Sediment (mg/kg)
< 31.00
31.00 - 61.99
62.00 - 123.99
124.00 - 197.49 (TEL)
197.50 - 271.00
> 271.00 (PEL)
Winter (March) 2001
Summer (August) 2001
0 5 10 15
Kilometers

Mercury


Mercury in Sediment (mg/kg)
< 0.033
0.033 - 0.064
0.065 - 0.129
0.130 - 0.409 (TEL)
0.410 - 0.696
> 0.696 (PEL)
Winter (March) 2001
Summer (August) 2001
0 5 10 15
Kilometers

TRACE METALS IN SEAWATER: AN ANALYTICAL CHALLENGE

- Estuaries and coastal oceans ecologically important receiving waters
- Trace metal levels can be low (sub-ppb)
- Ultra-clean methods required
- Analytically difficult matrix
  - Not well covered in EPA 1600's methods
  - Extraction / pre-concentration required to obtain accurate data

FACTORS AFFECTING TRACE METALS DATA QUALITY

- **Sample collection (Field)**
  - Must be representative of the region
  - Minimize contamination during collection and post collection sample handling
  - Carefully cleaned plastic ware and equipment
  - Clean hands & dirty hands approach
  - On-site filtration for dissolved measurements
  - Low detection limits require low blanks
    - Blanks taken at start and end of sampling day

CLEAN METALS CHEMISTRY

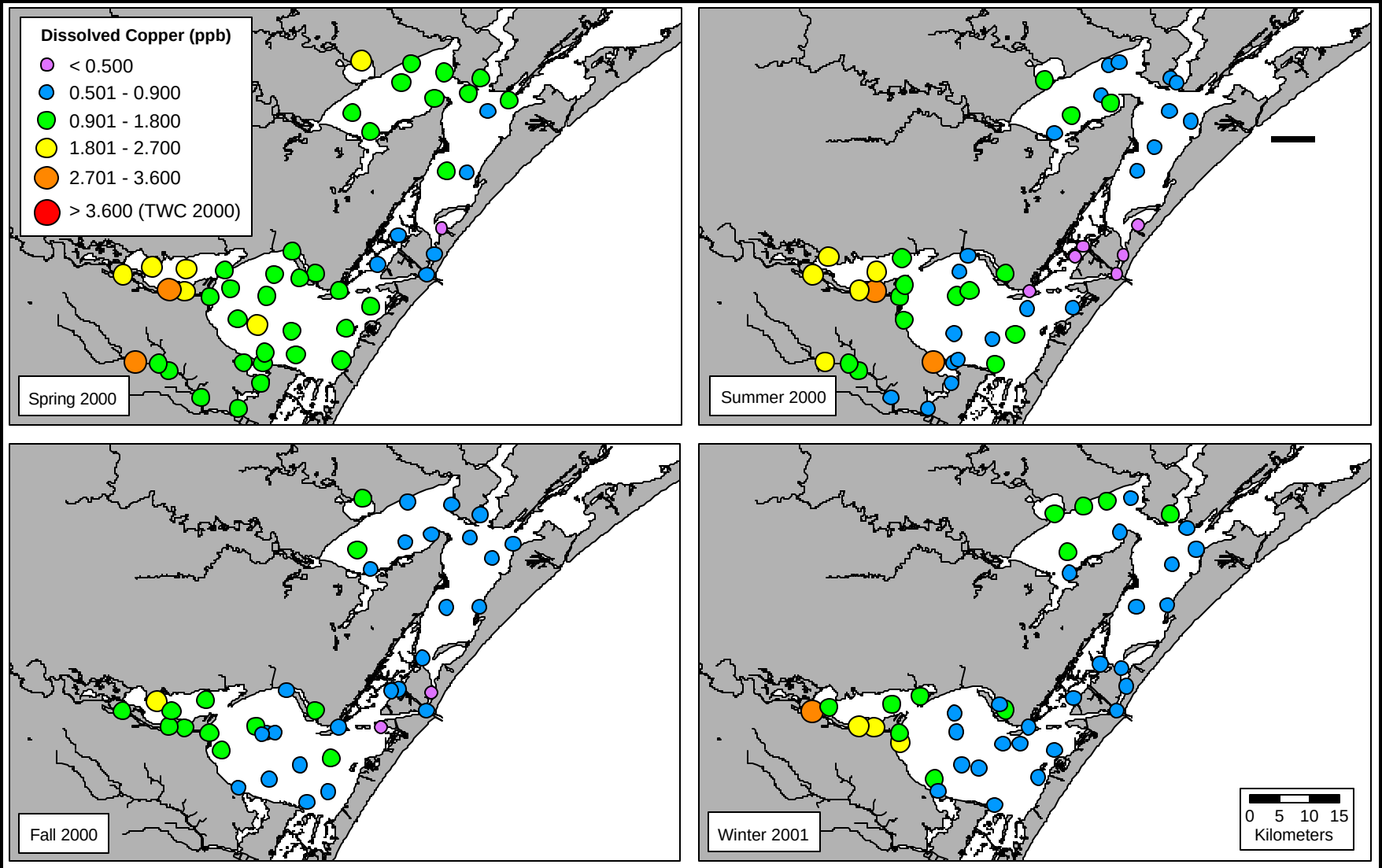
- **Laboratory Sample Analysis**
  - Comprehensive QA procedures
  - Minimize contamination during preparation & analysis
  - Clean, sensitive analytical methods
  - Control matrix interferences (from seawater)
    - Avoid inaccurate data- false positives or false negatives

- **Focus on data accuracy!**

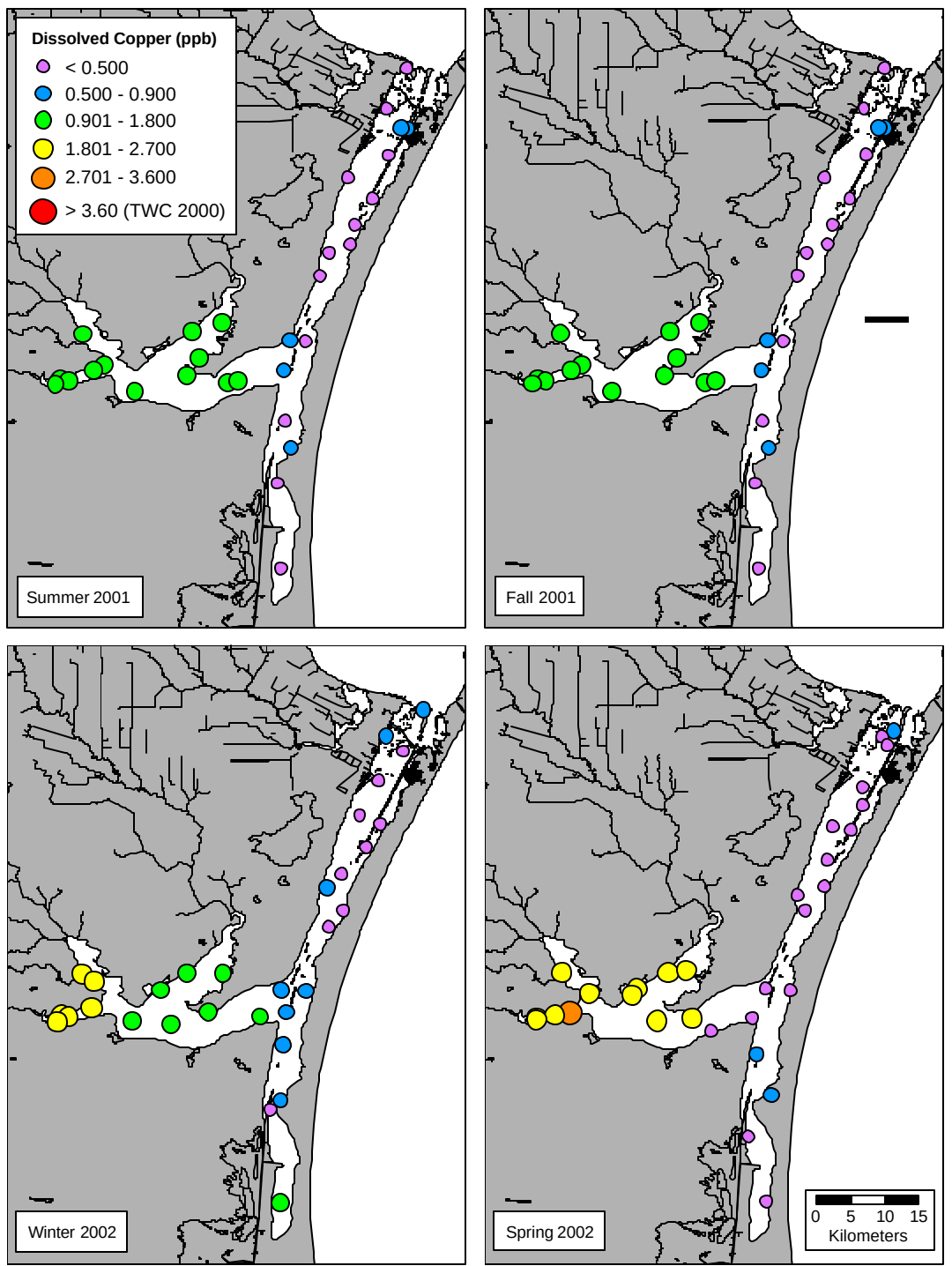
Trace Metals

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Mercury
- Selenium
- Silver
- Zinc

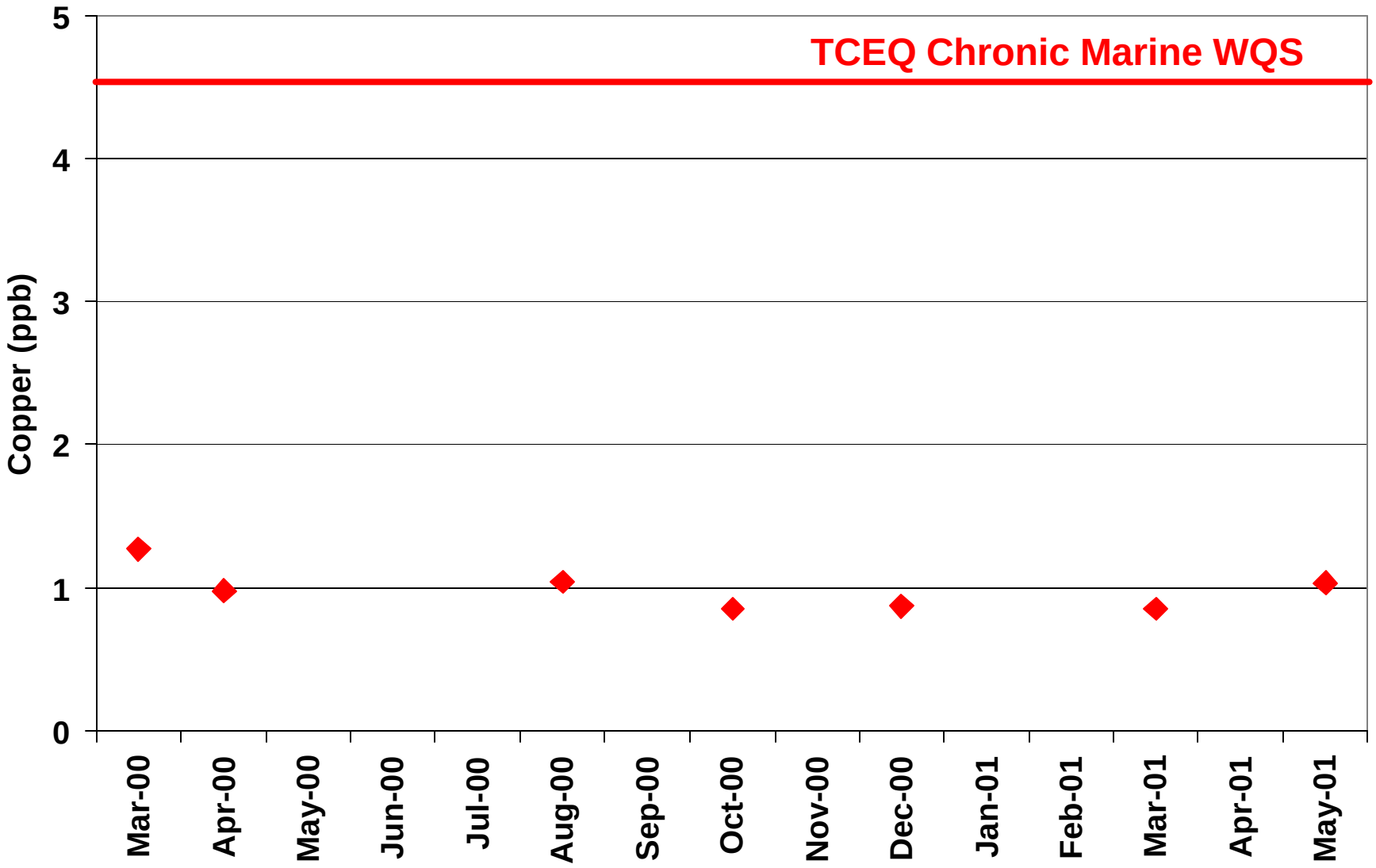
Dissolved Copper



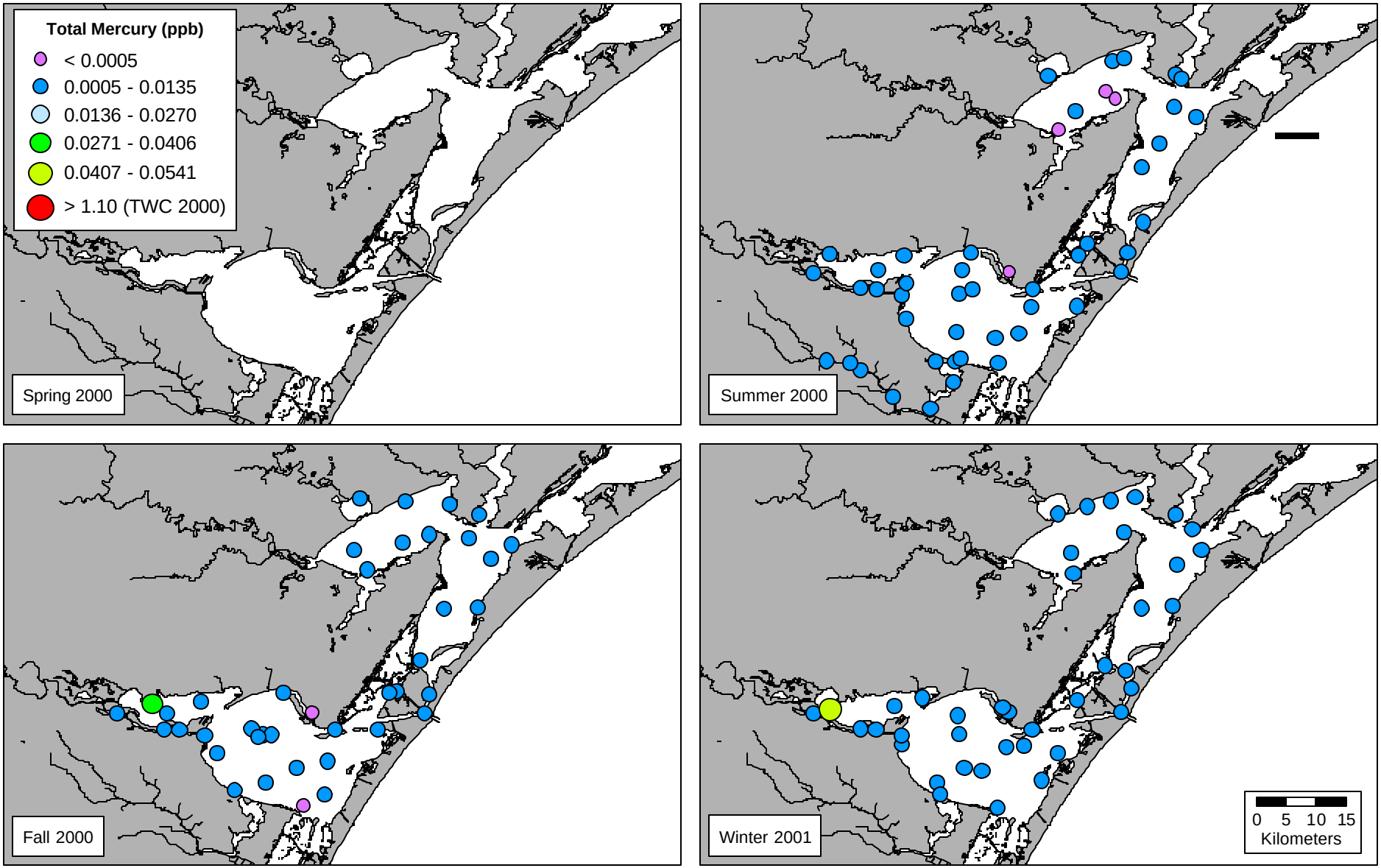
Dissolved Copper



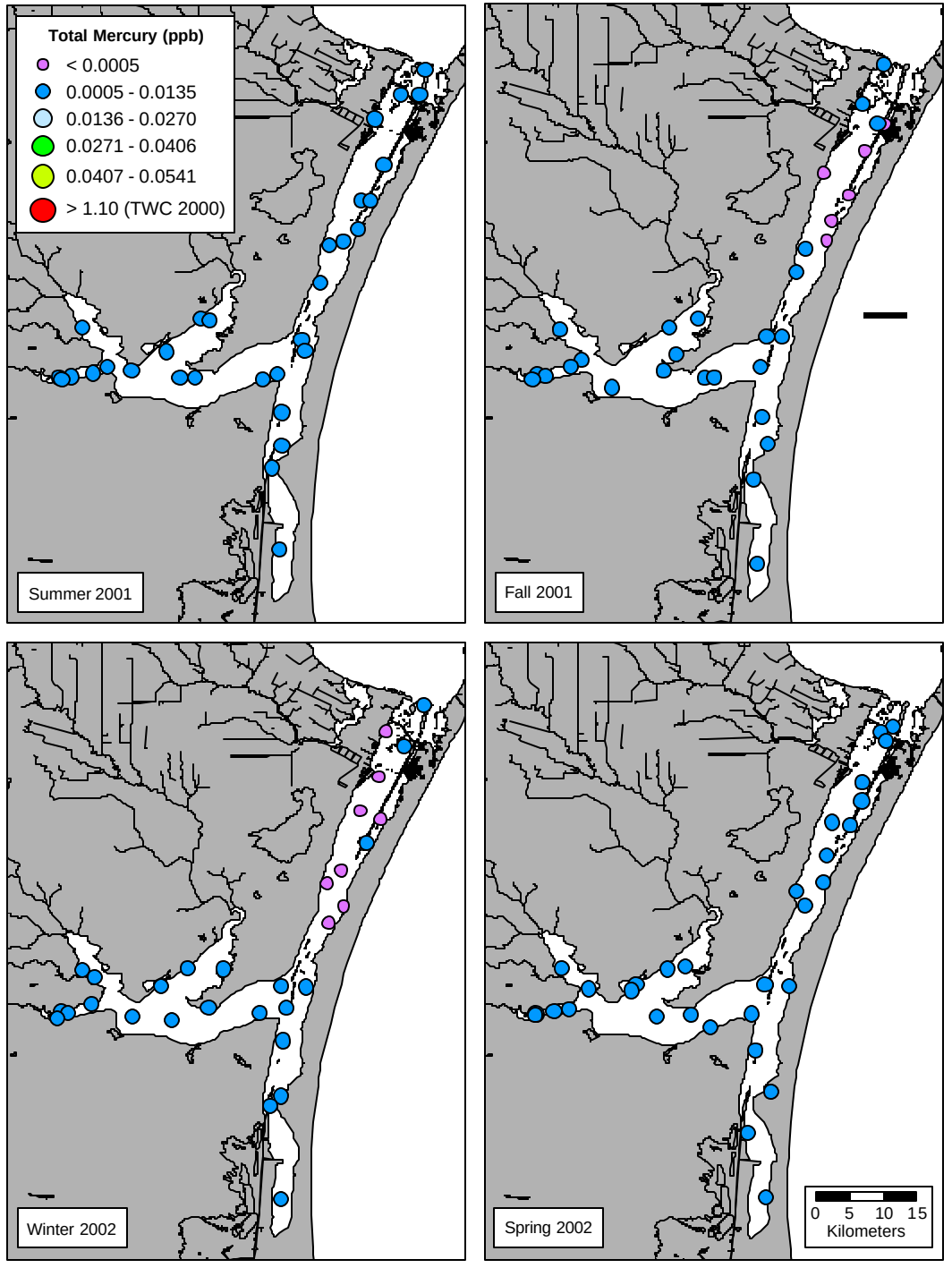
DISSOLVED COPPER - STATION 13407

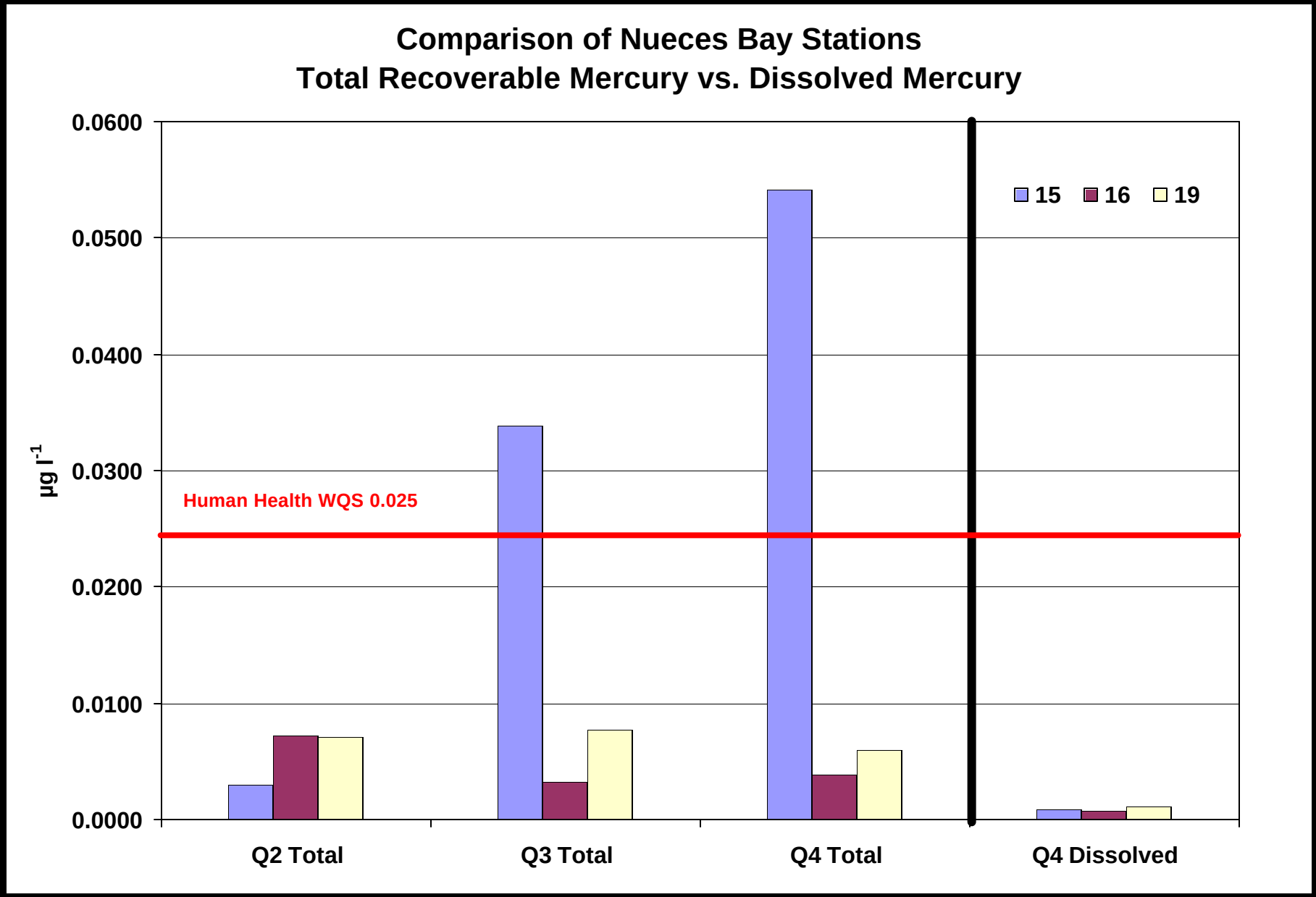


Total Mercury

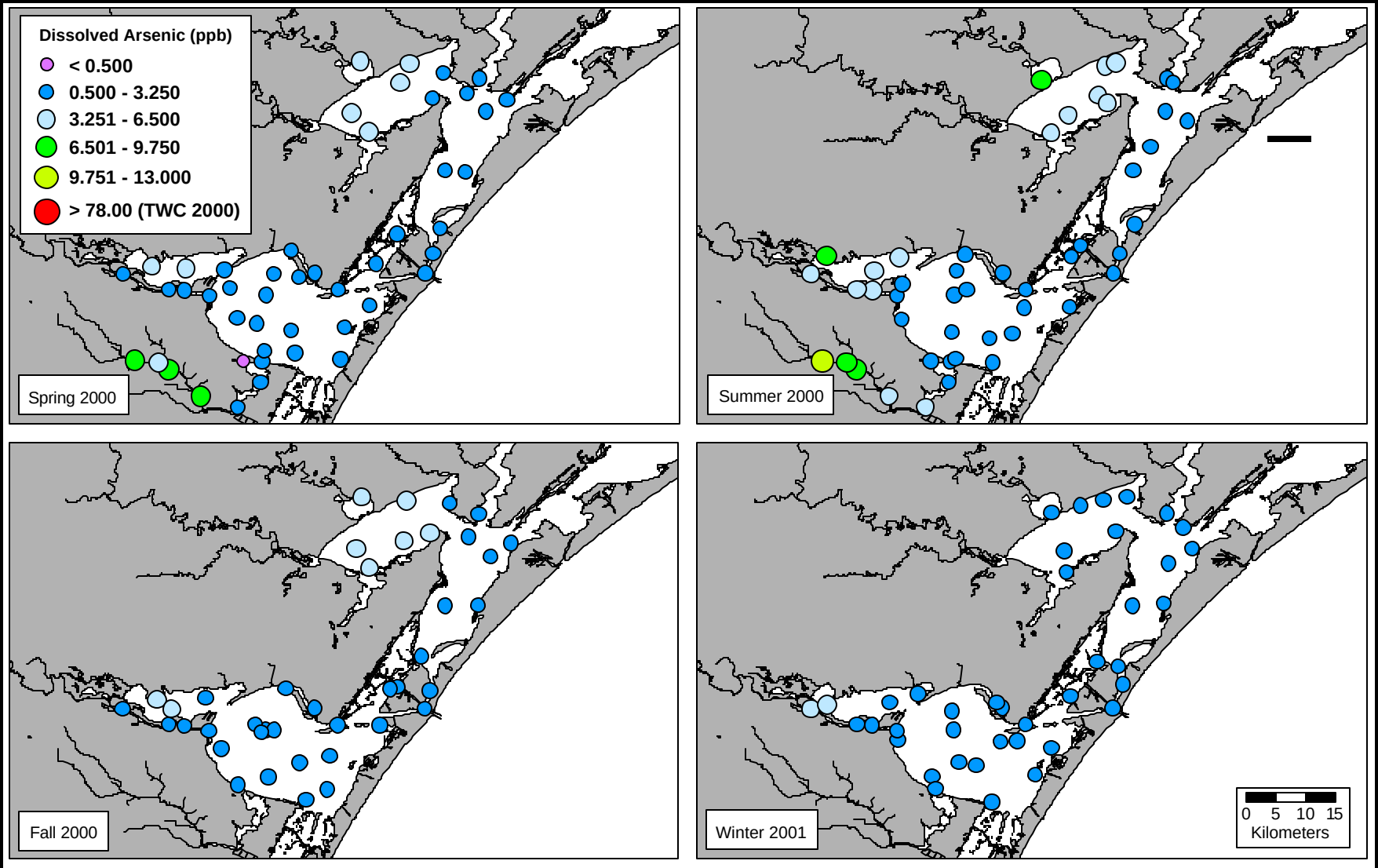


Total Mercury

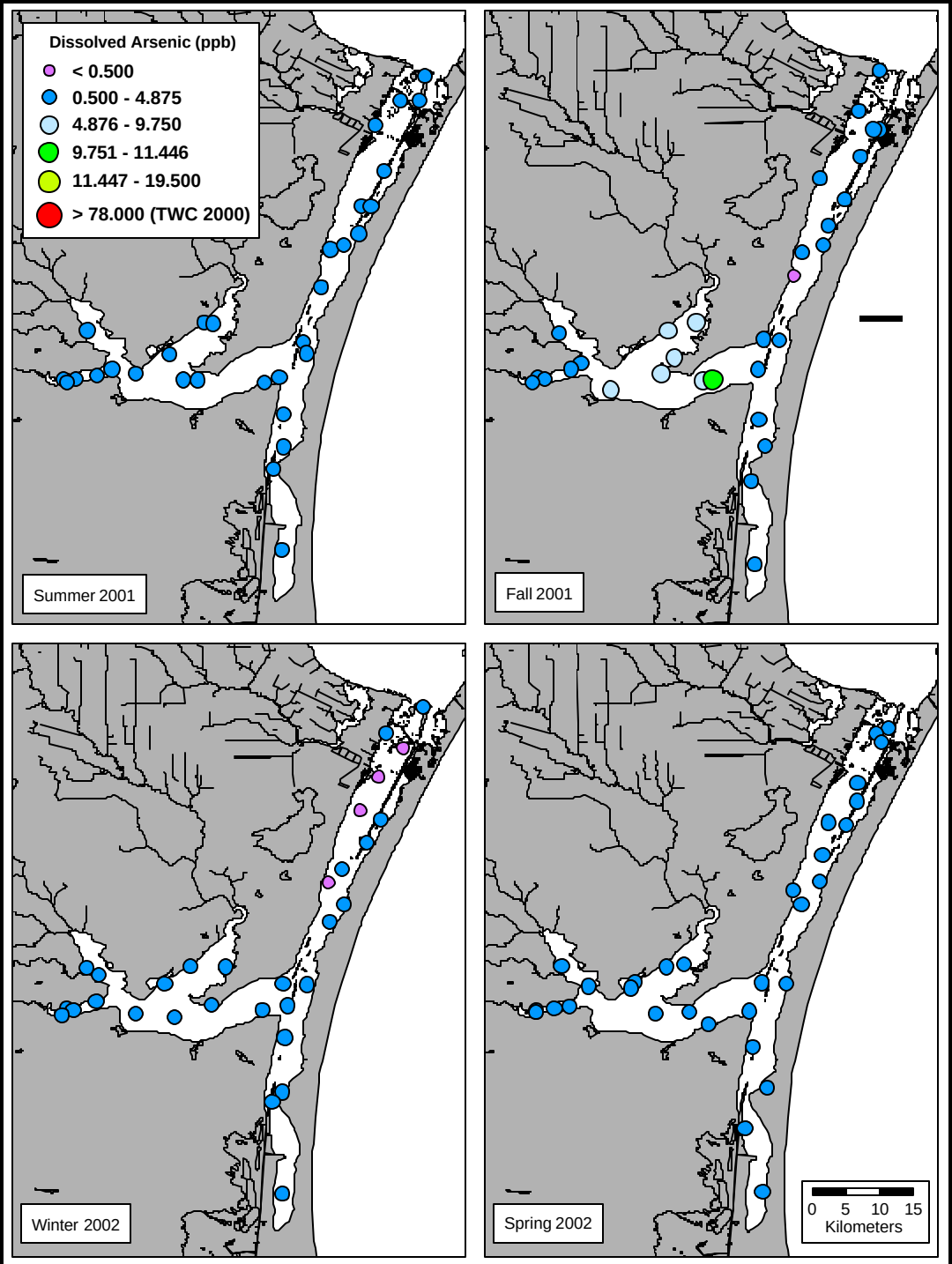



Comparison of Nueces Bay Stations
Total Recoverable Mercury vs. Dissolved Mercury
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
µg l-1
Human Health WQS 0.025
15
16
19
Q2 Total
Q3 Total
Q4 Total
Q4 Dissolved

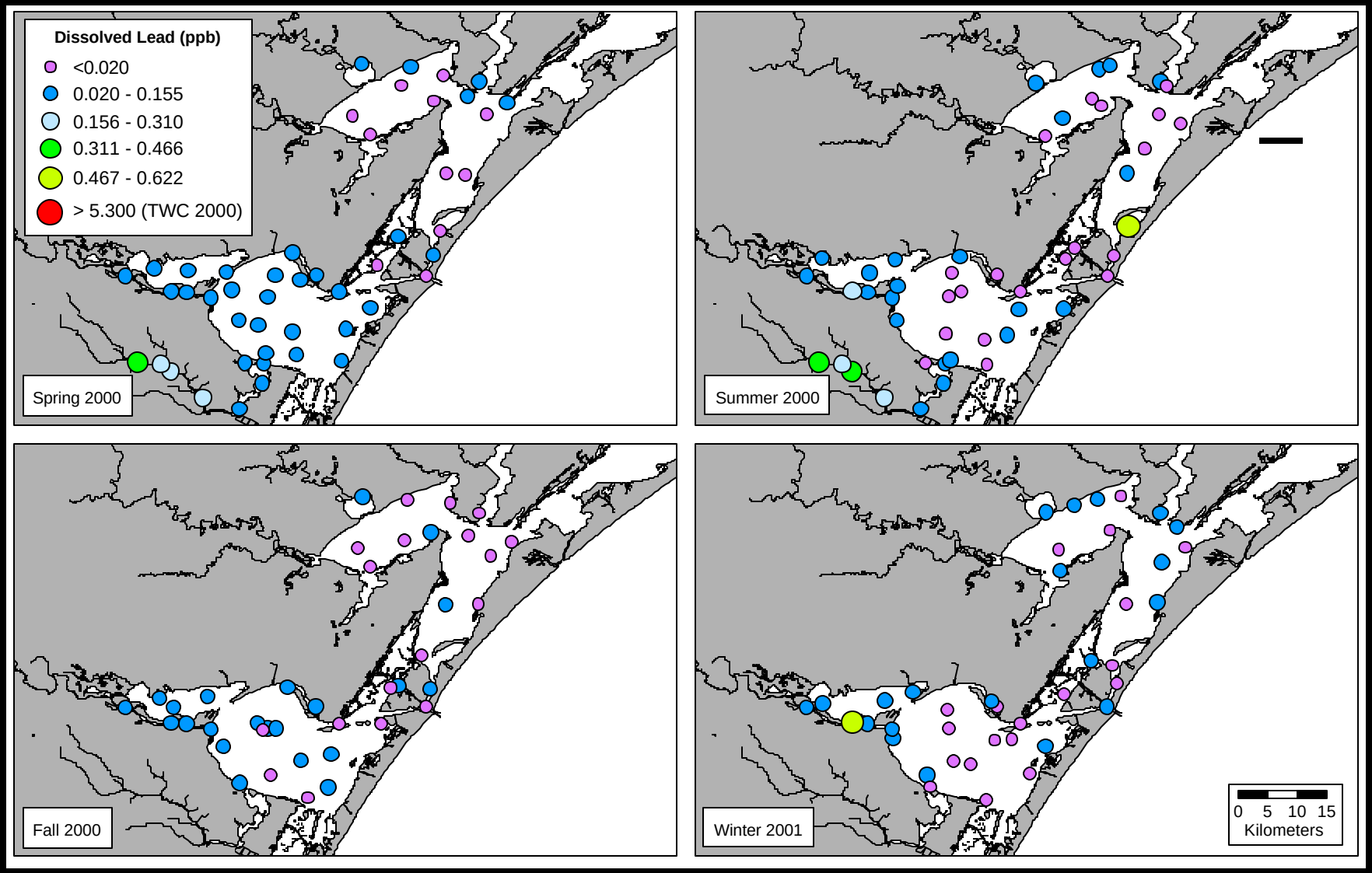
Dissolved Arsenic



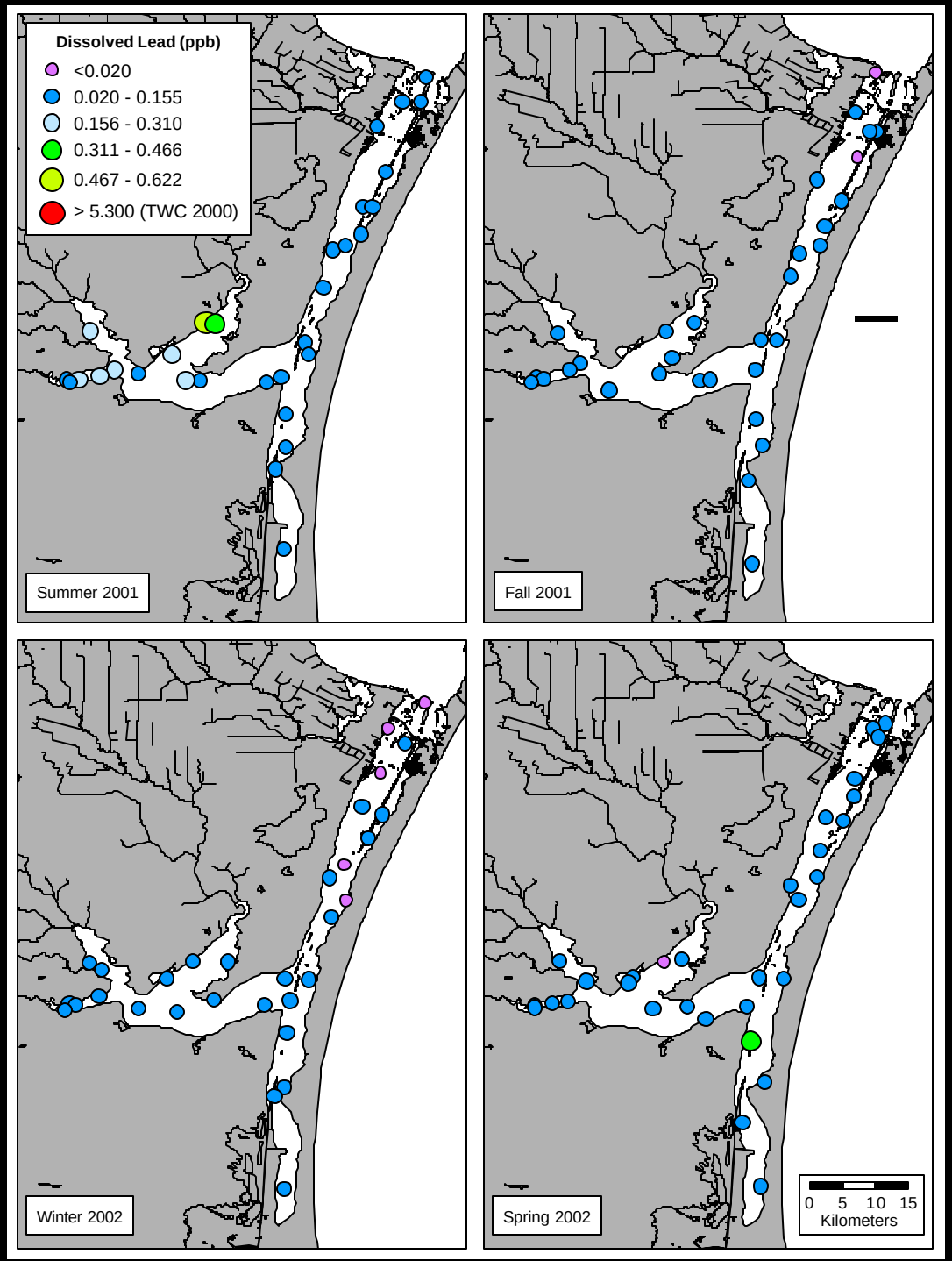
Dissolved Arsenic



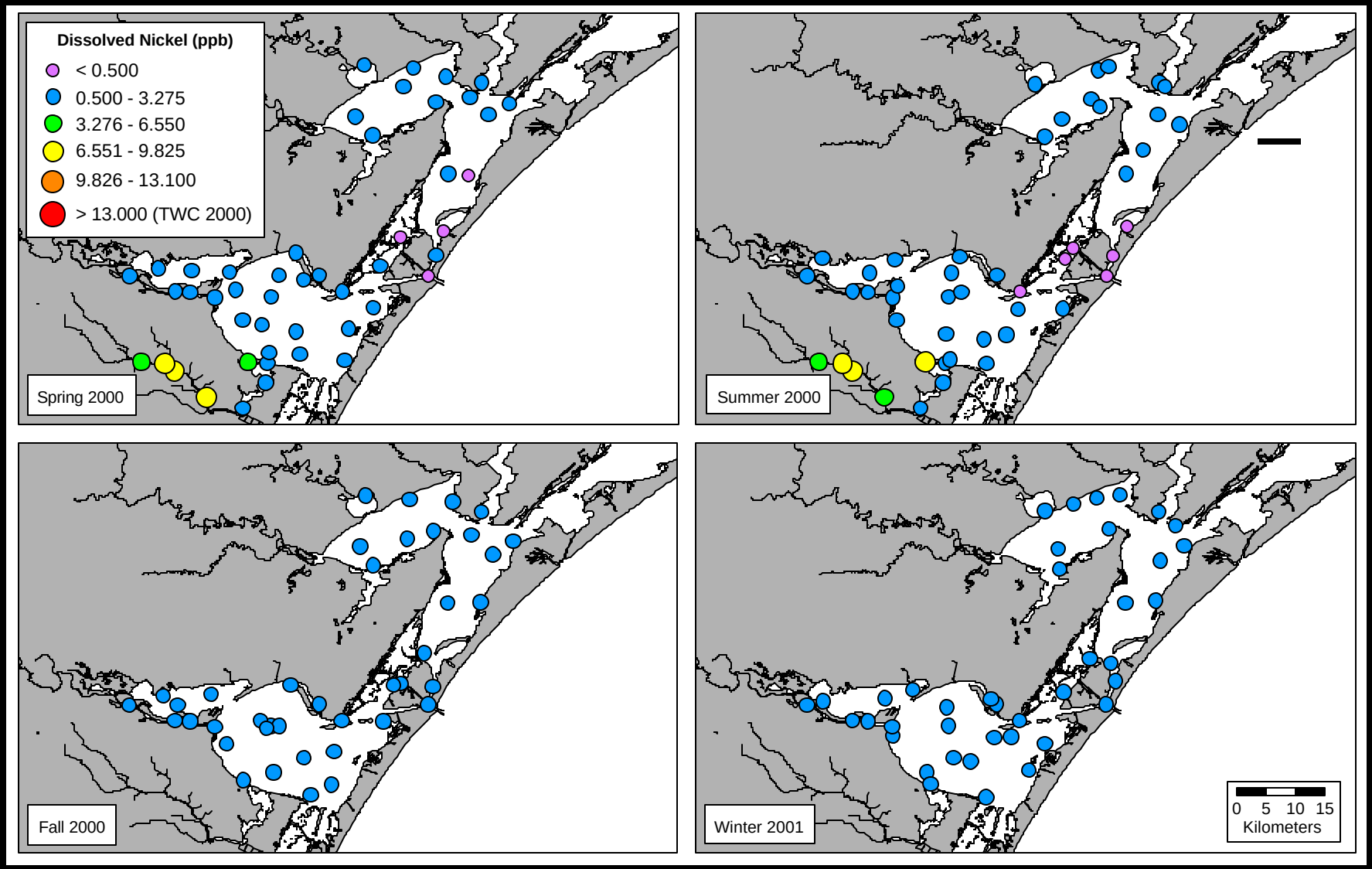
Dissolved Lead



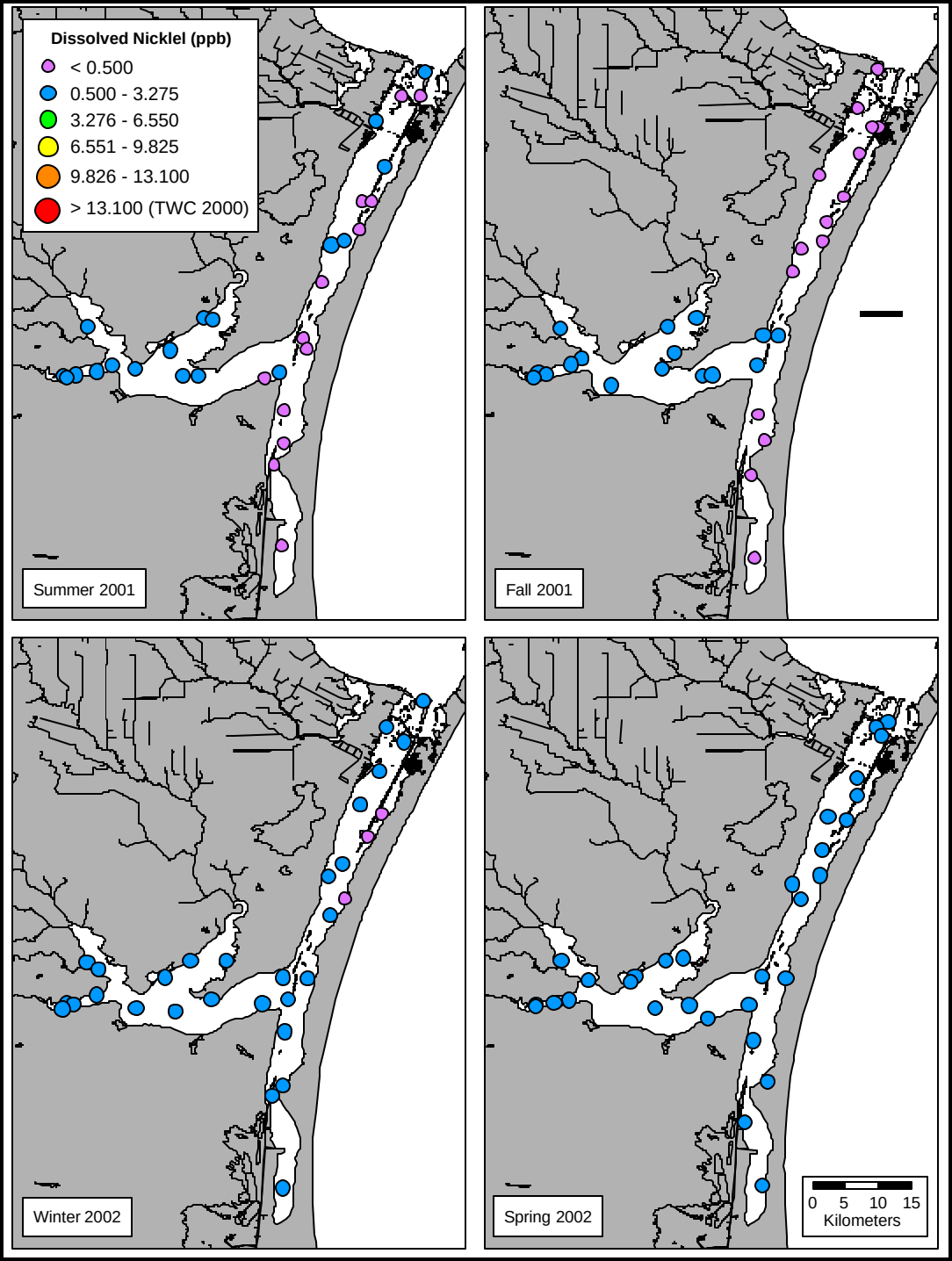
Dissolved Lead



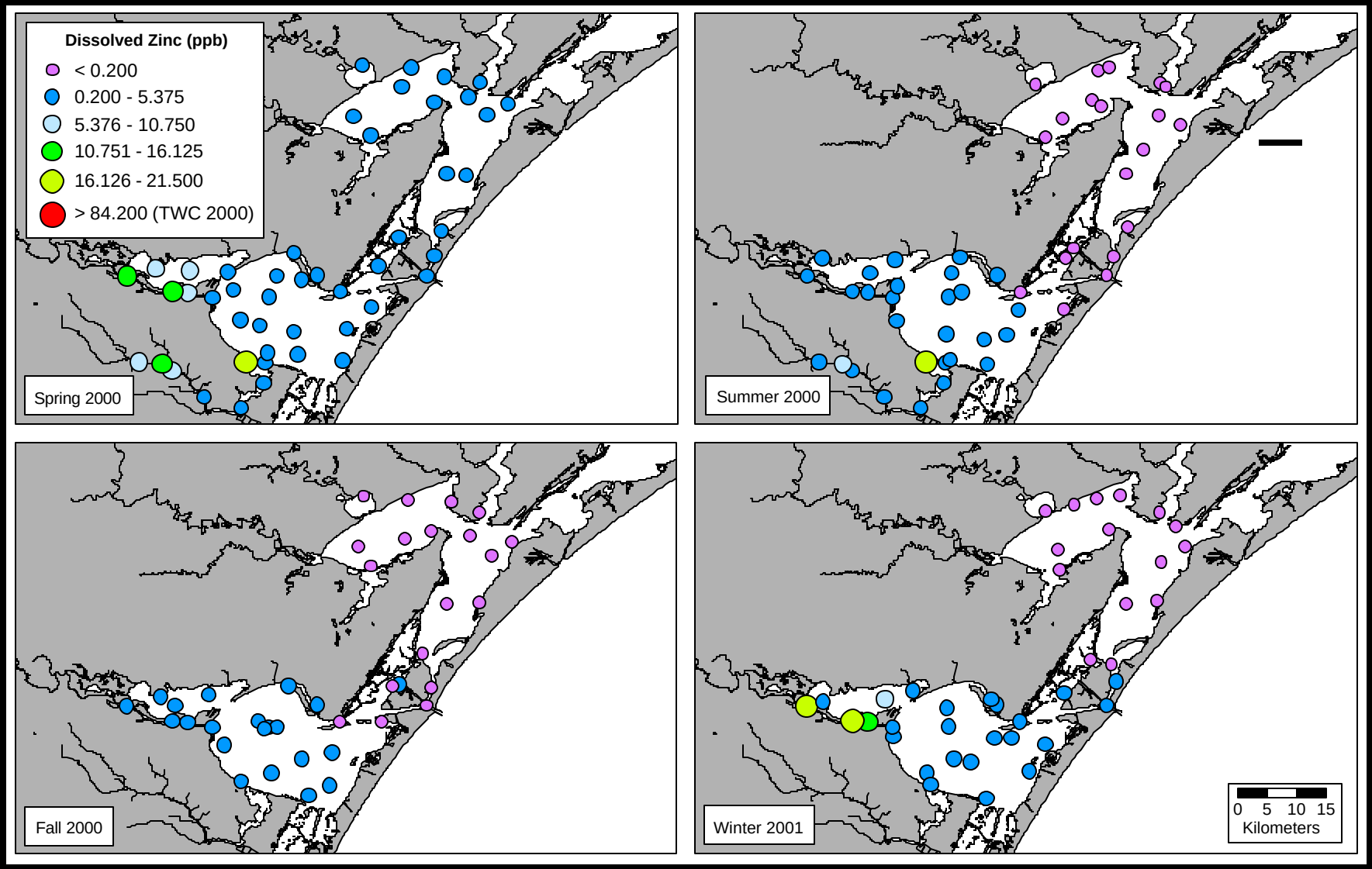
Dissolved Nickel



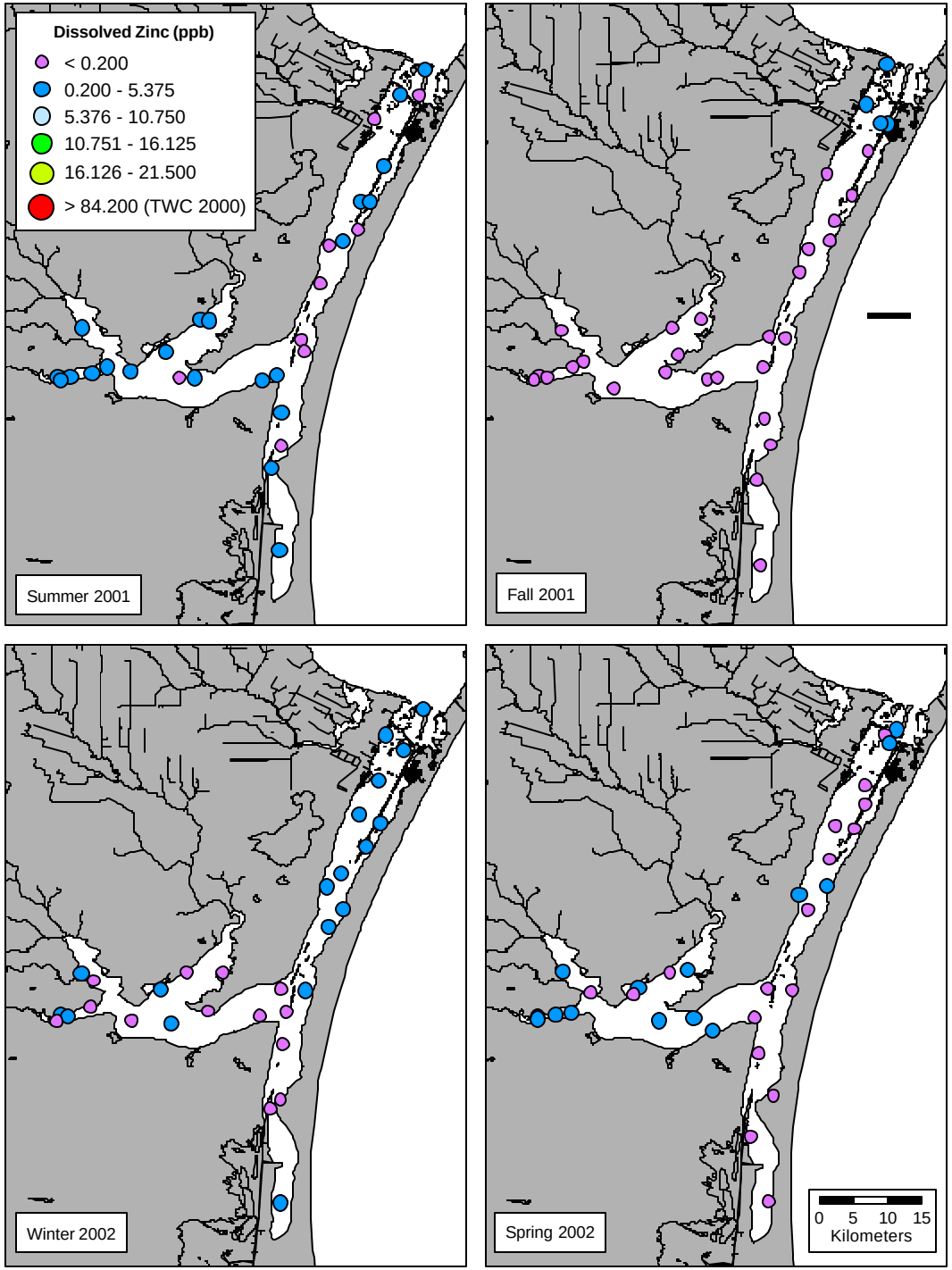
Dissolved Nickel



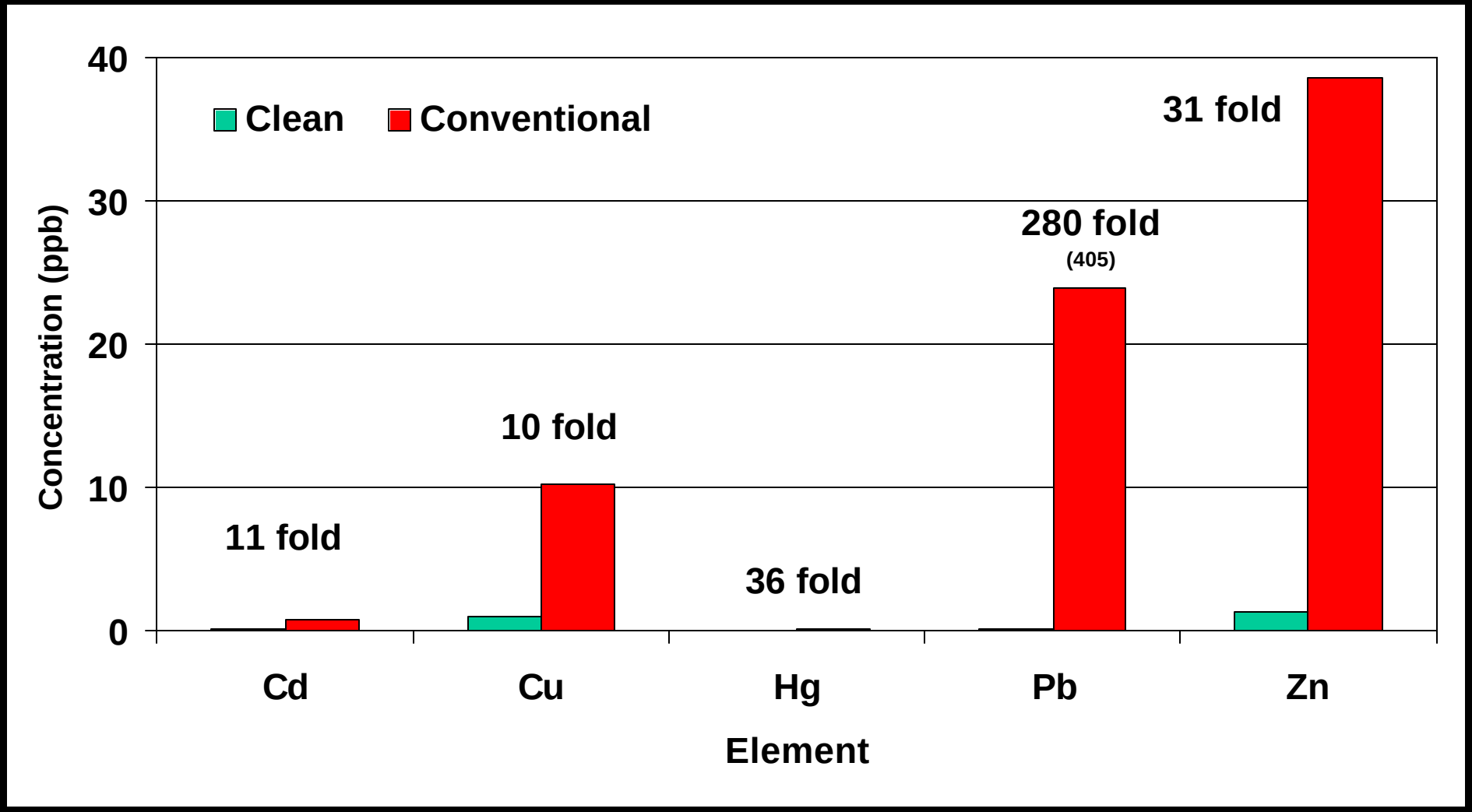
Dissolved Zinc



Dissolved Zinc



HISTORICAL vs. CLEAN METALS DATA



Source of historical data: Ward and Armstrong (1997)

CONCLUSIONS

- **Ambitious, extensive monitoring study**

- **RCAP accomplished primary objectives**
  - **Scientifically sound, extensive Water Quality data set**
  - **Superior quality compared to historical monitoring data**
  - **Provided data missing from under sampled areas**

- **Precise localization of anthropogenic influences**

Conclusions

- **Water and sediment quality concerns identified**
  - **DO in Oso Creek / Oso Bay (currently listed / studies in progress)**
  - **Ammonia in Oso Bay (OWWTP), Inner Harbor, Baffin Bay Complex**
  - **Total Phosphorus in Oso Creek, Oso Bay, Nueces Bay, and Baffin Bay Complex**
  - **Chlorophyll a in Oso Creek (GWWTP), Inner Harbor, Baffin Bay Complex, and some parts of Upper Laguna Madre**
  - **Copper, Lead, Zinc, and <u>Mercury</u> in sediment at Station 21**
  - **Elevated levels of Mercury in Nueces Bay (TSS related)**

Conclusions

- **Clean aqueous metals data an important addition to sediment contaminants data**
  - Aqueous data may be a better integrated index of WQ
  - Clear spatial trends for most metals
  - Even zinc exhibits consistent trend
  - Recurrent monitoring could identify future trends in toxic metals pollution in the region
- **Remaining data gap is to obtain accurate clean metals measurements for permitted discharges into the system**

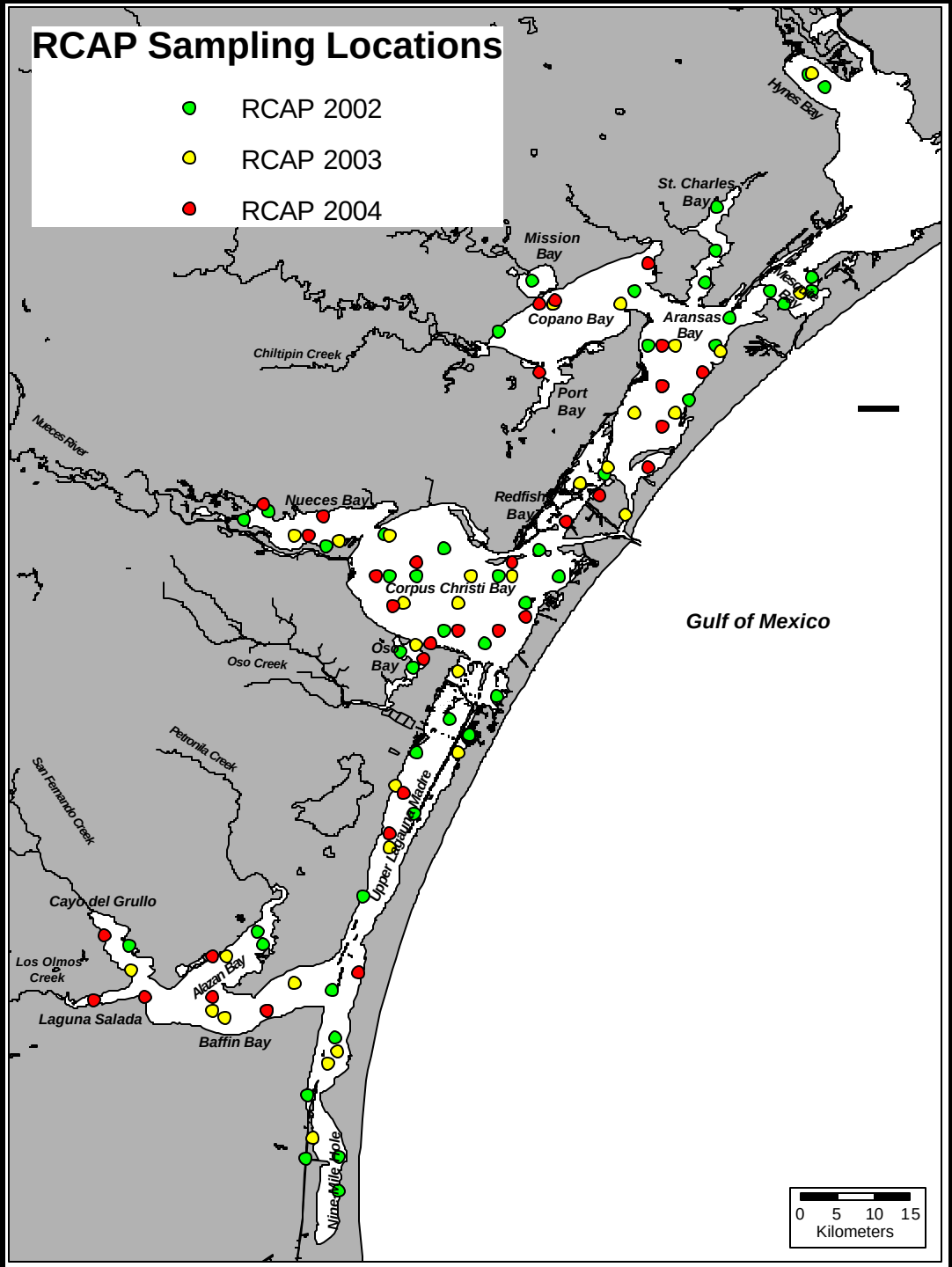
What does it all mean and what can we do?

- Development and progress are inevitable
- Quality of our resources concerns everyone
- Cooperation is essential
- Partnerships are fundamental

Partnerships and Commitment

National Coastal Assessment

- **EPA and TPWD**
  - 50 Stations in Texas
  - Averaged 10 – 15 CBBEP
  - 100 Stations in Texas
- **CBBEP**
  - RCAP 2002 – 50 Stations
  - RCAP 2003 – 32 Stations
  - RCAP 2004 – 32 Stations



The benefits of sampling in the early morning!