

Issues and Solutions for Agricultural Plastic

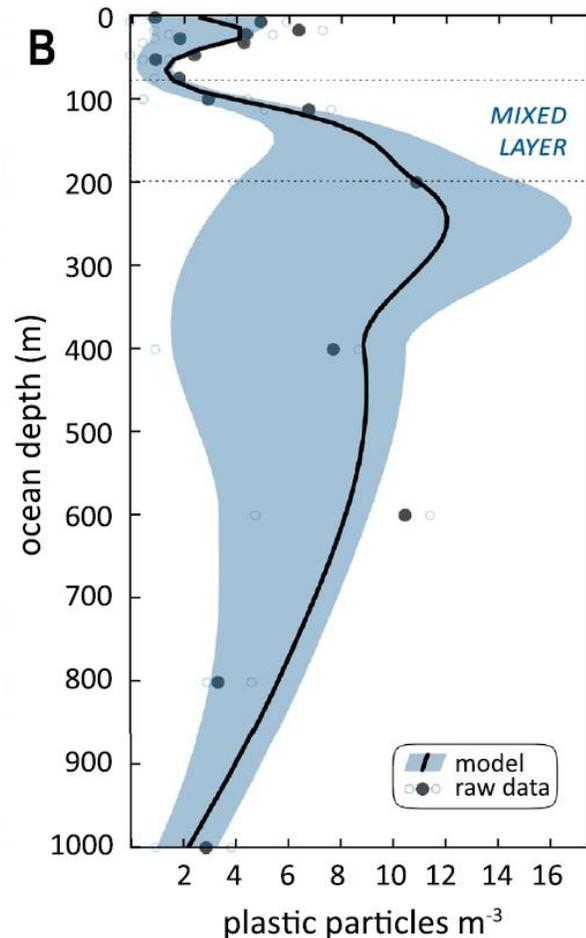
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Presentation Topics

1. How agricultural plastic use relates to the MBARI study on microplastics in Monterey Bay
2. Agricultural Plastic Use in Monterey
3. Plastic on stream banks and microplastic in local streams and drainage outlets
4. Biodegradable Plastic Mulch for use in Strawberries
5. Other plastic solutions or potential ideas for agriculture
6. How do we carry this forward to solutions?

Vertical Distribution of Marine Microplastic in Monterey Bay



- Plastic is found throughout all depths in the water column of Monterey Bay
- The highest concentration was not on the surface
- The predominant type was PET, as in single use plastic bottles

Choy et al. 2019 The vertical distribution and biological transport of marine microplastics ...

Plastic Types Found in Monterey Bay



Polyethylene Terephthalate (PET)



Poly Amide (PA/ nylon)



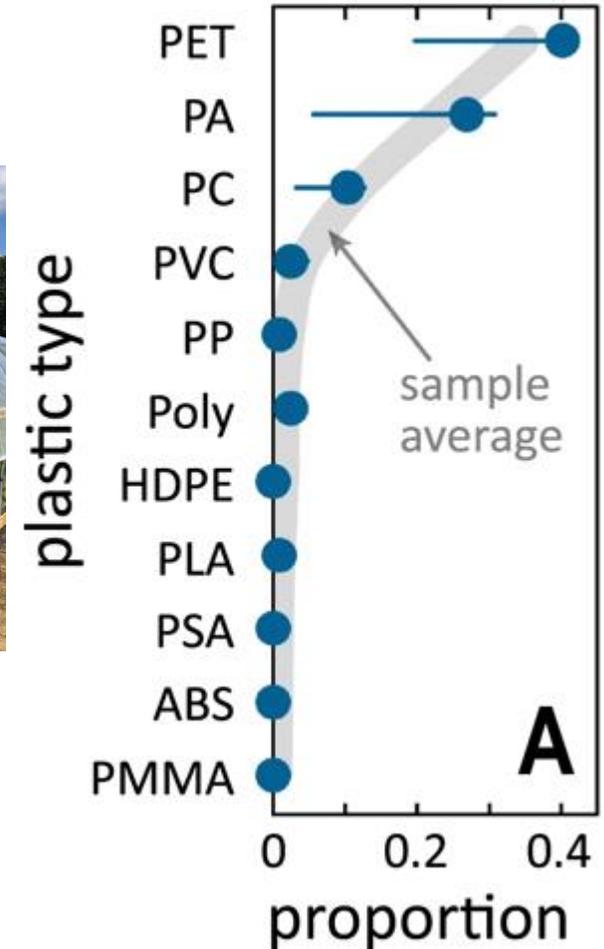
Polycarbonate (PC)



Poly Vinyl Chloride: PVC

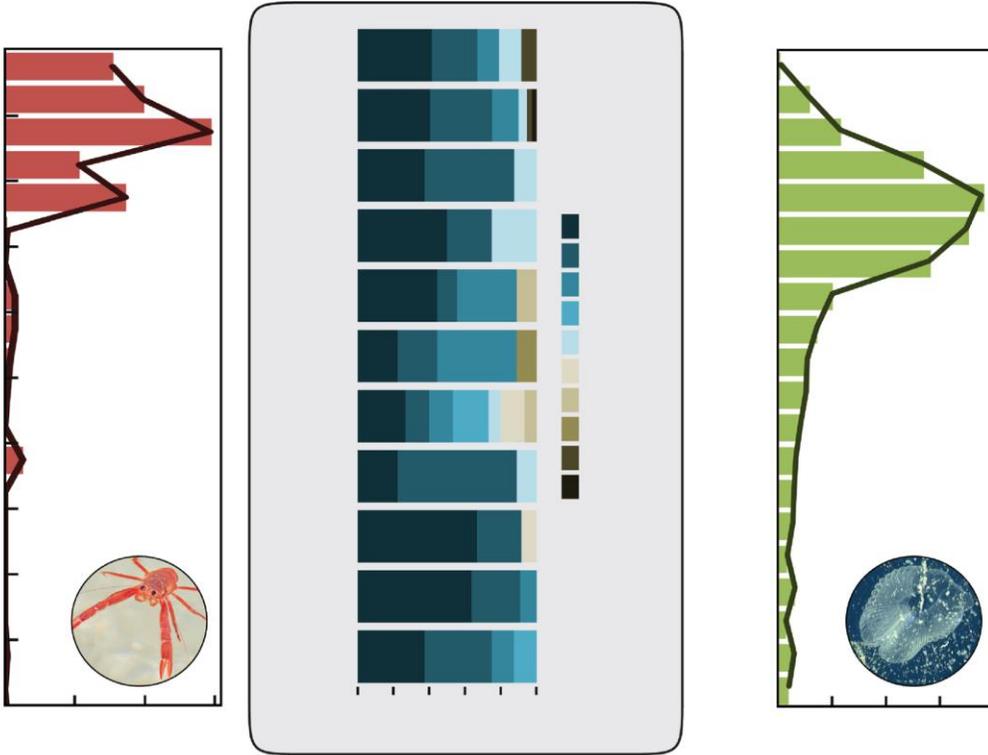


Poly Propylene (PP)



Abrv.	Plastic	Agricultural uses	Urban Uses
PET	Polyethylene terephthalate	Strawberry and tomato containers Clamshell containers	Water bottles, food packaging
PA	Polyamide/ nylon	Strapping tape, layer in fumigation tarp	Car tires, clothing, rope
PVC	Polyvinyl Chloride	Irrigation tubing	Plumbing pipe
PP	Polypropylene	Animal Exclusion Fencing, nursery pots, twine, seed bags, green woven berry boxes	Packaging, textiles, fishing gear, straws
Poly	Polyester	Strapping tape, Clamshell packaging	Textiles
HDPE	High density Polypropylene	Drip tape	Plastic Containers
LDPE	Polyethelyne	Plastic mulch, plastic bags	Plastic bags

* Many materials are made from more than one plastic type. Eg strapping tape can be nylon, polyester, or polypropylene

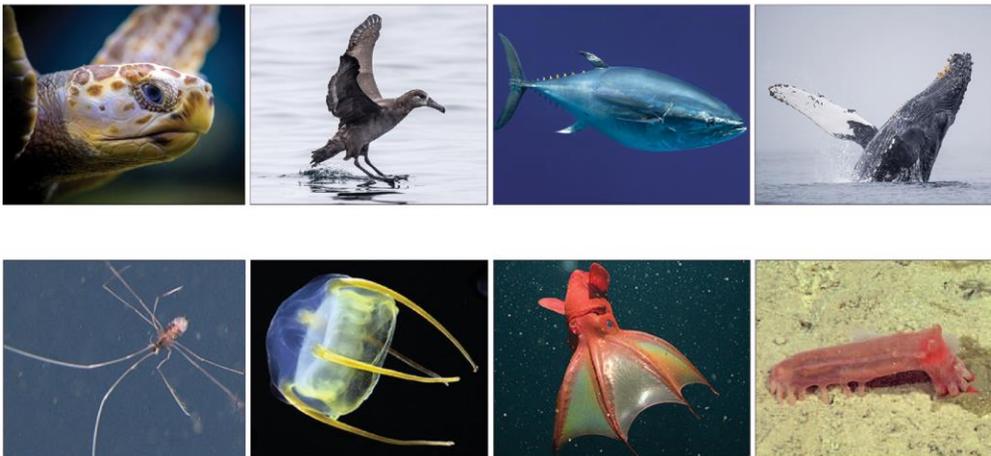


Microplastics Ingested at the Bottom of the food web can move up the chain.

Plastics themselves may be toxic and also attract other toxins in the water column.

Effects of plastic ingestion are sublethal, but influences may effect populations' ability to deal with other stressors. Long term population effects unknown.

Plastic does break down through digestion and other marine processes.



Facts about Ocean Plastic

- From the tiniest plankton to the largest whales, plastics impact nearly 700 species in our ocean.
- Plastic has been found in more than 60% of all seabirds. All types of turtles and 50% of turtles examined have ingested plastic.
- Every year, 8 million metric tons of plastics enter our ocean on top of the estimated 150 million metric tons that currently circulate our marine environments.
- Globally, it is estimated that over **100 million** marine animals are killed each year by plastic waste.
- In birds, the ingestion of plastic has been found to remodel the tiny fingerlike projections inside the small intestine, disrupt iron absorption and add to stress on the liver.
- Flesh-footed shearwaters eat more plastic as a proportion of their body mass than any other marine animal.
- Chemicals adhere to plastics and cause toxicity - pesticides, ultraviolet stabilizers, water repellents, flame retardants, stiffeners such as bisphenol A (BPA), and softeners called phthalates.

What Values does ag field plastic provide

Increases the length of the growing season.

Increases yield and reduces weeding.

Reduces reliance on herbicides,

Increases water efficiency,

Controls diseases and pests.

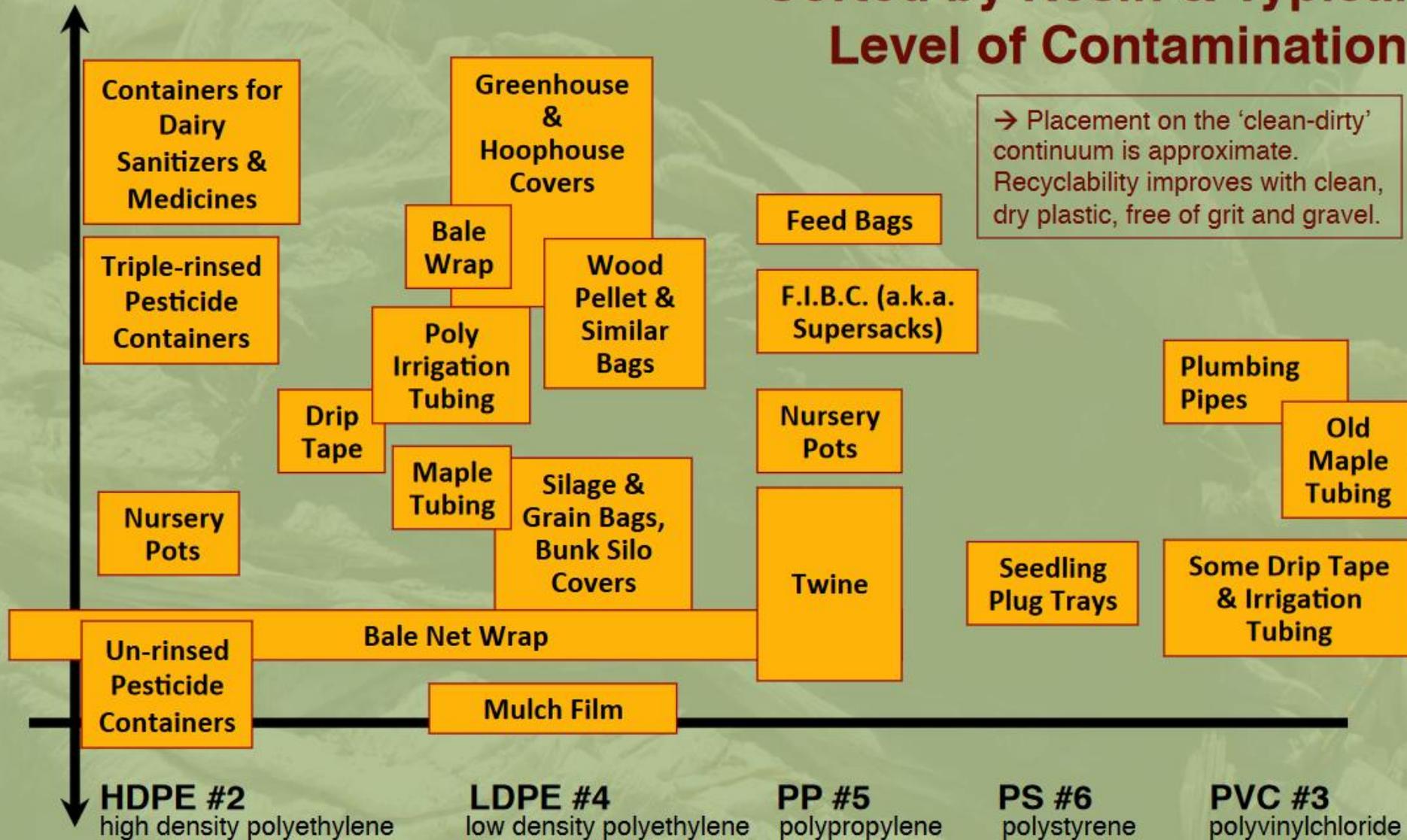


Agricultural plastic is important to crop quality, yields, weed suppression, labor reduction and conservation of water.

Used Agricultural Plastics

Sorted by Resin & Typical Level of Contamination

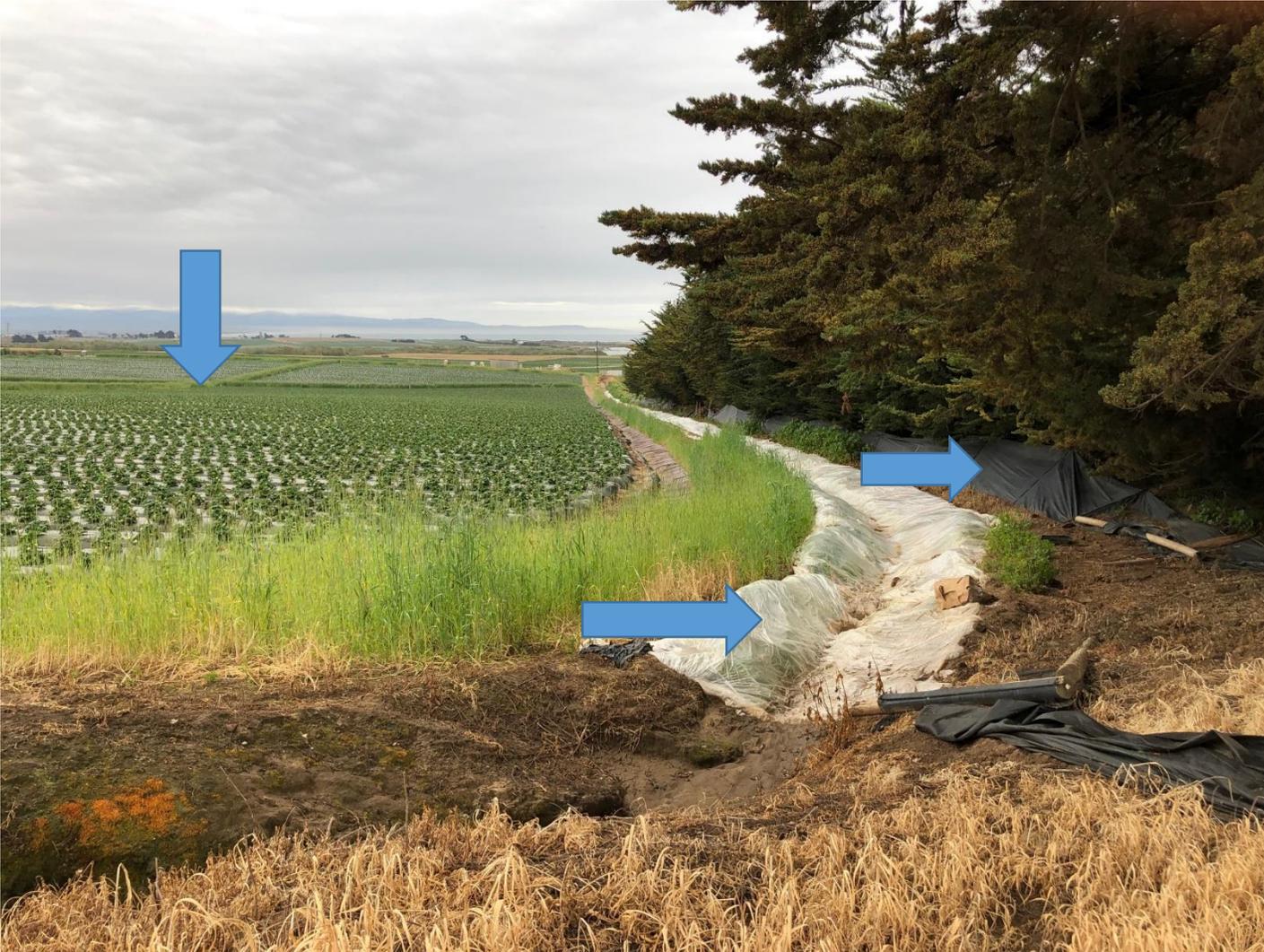
CLEANER



DIRTIER

Figure from Levitan, Cornell University

How is Plastic Used in Agricultural Fields?



Monterey County:
26.7 million lbs./year

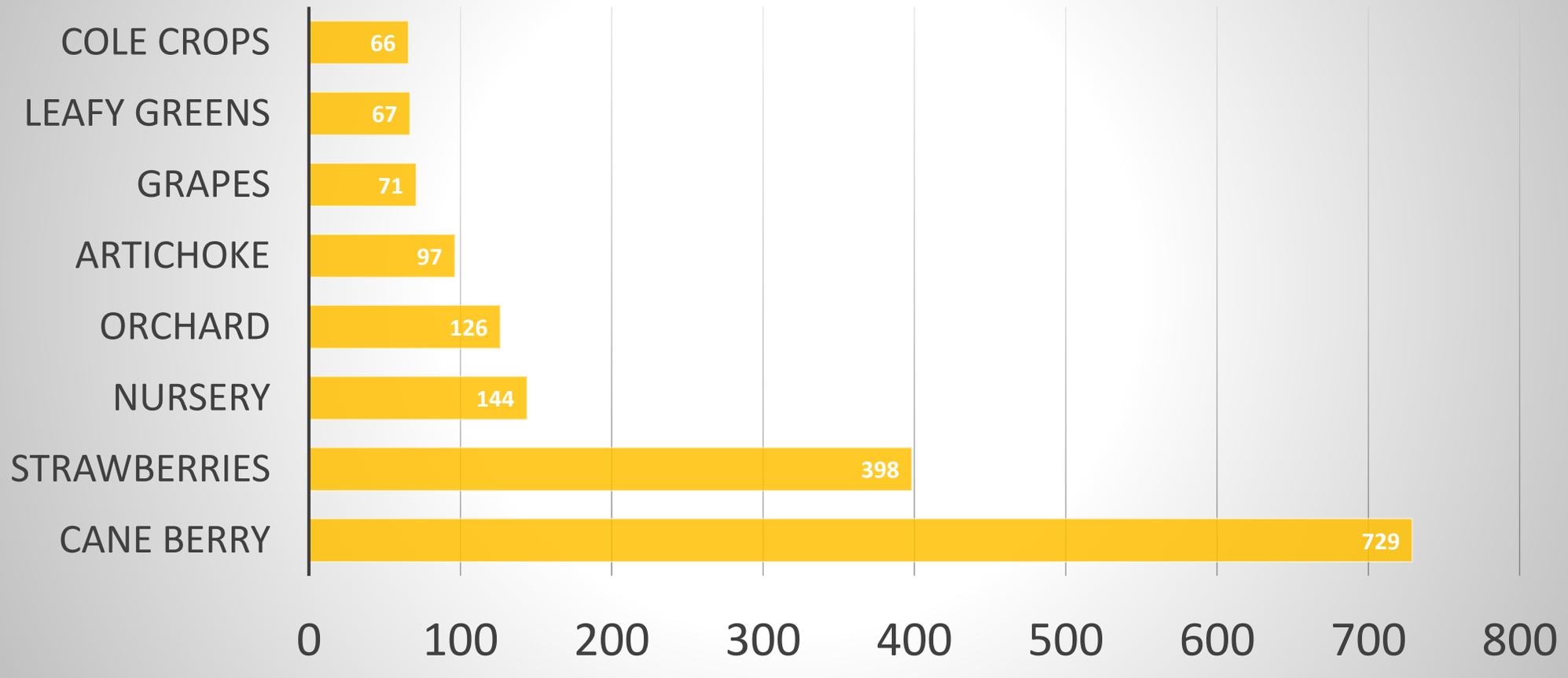
- Mulch
- Irrigation Tubing
- Fumigation Tarp
- Hoop houses

Other Uses:

- Ditch Lining
- Animal Fencing
- Protective Equip.
- Containers

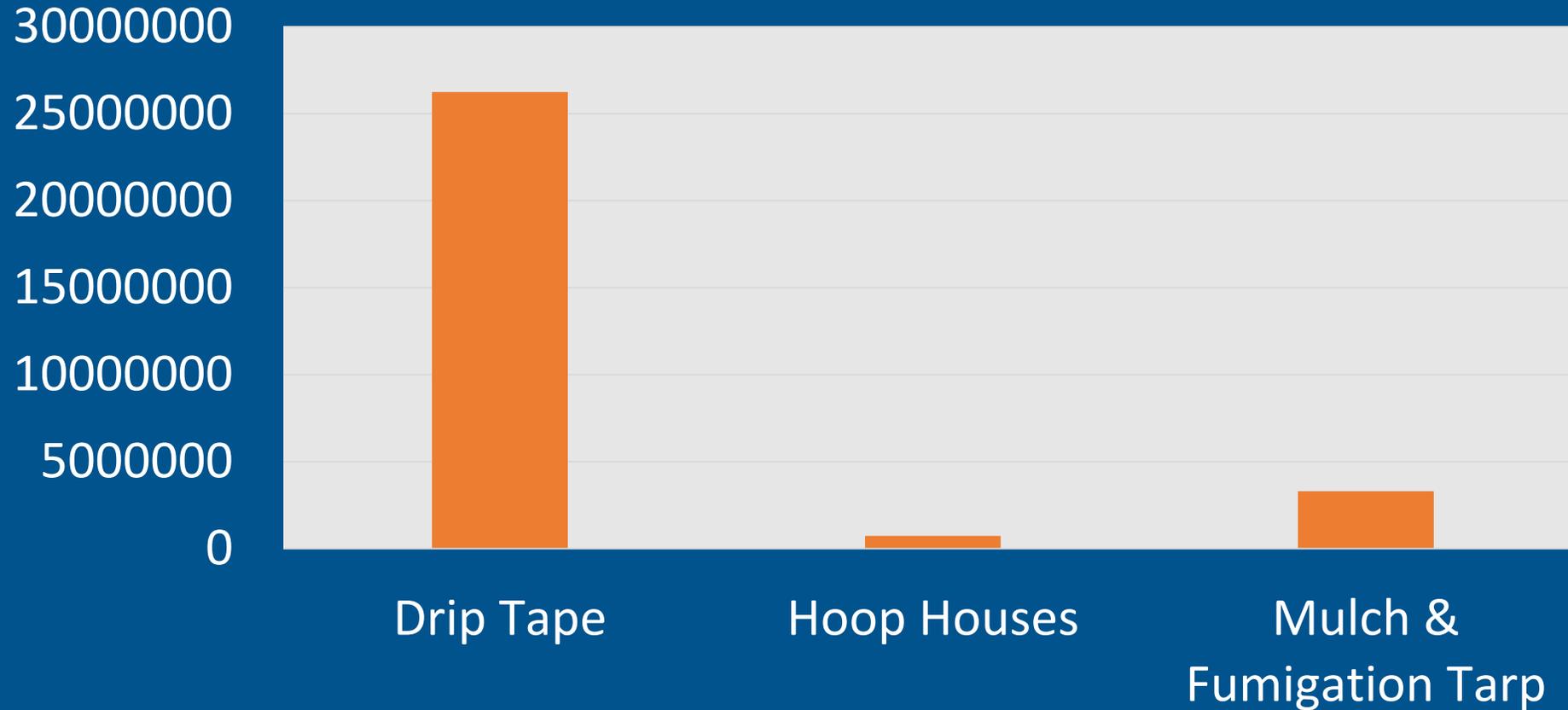
Monterey County by Crop Type

Field Plastic (lb/acre/year)



Amount of Field Plastic Use by Function

Plastic Use (lb/year)



Bank Plastic:

Gabilan Creek

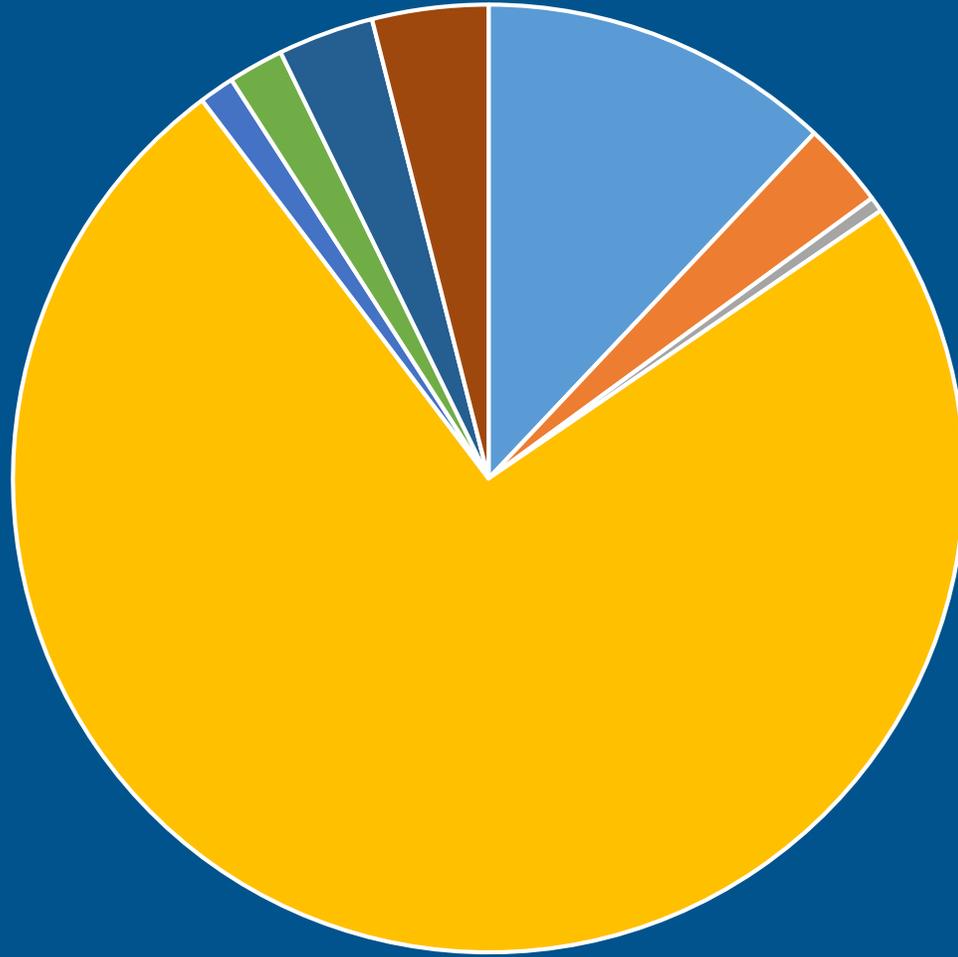


Quail Creek



Tembladero

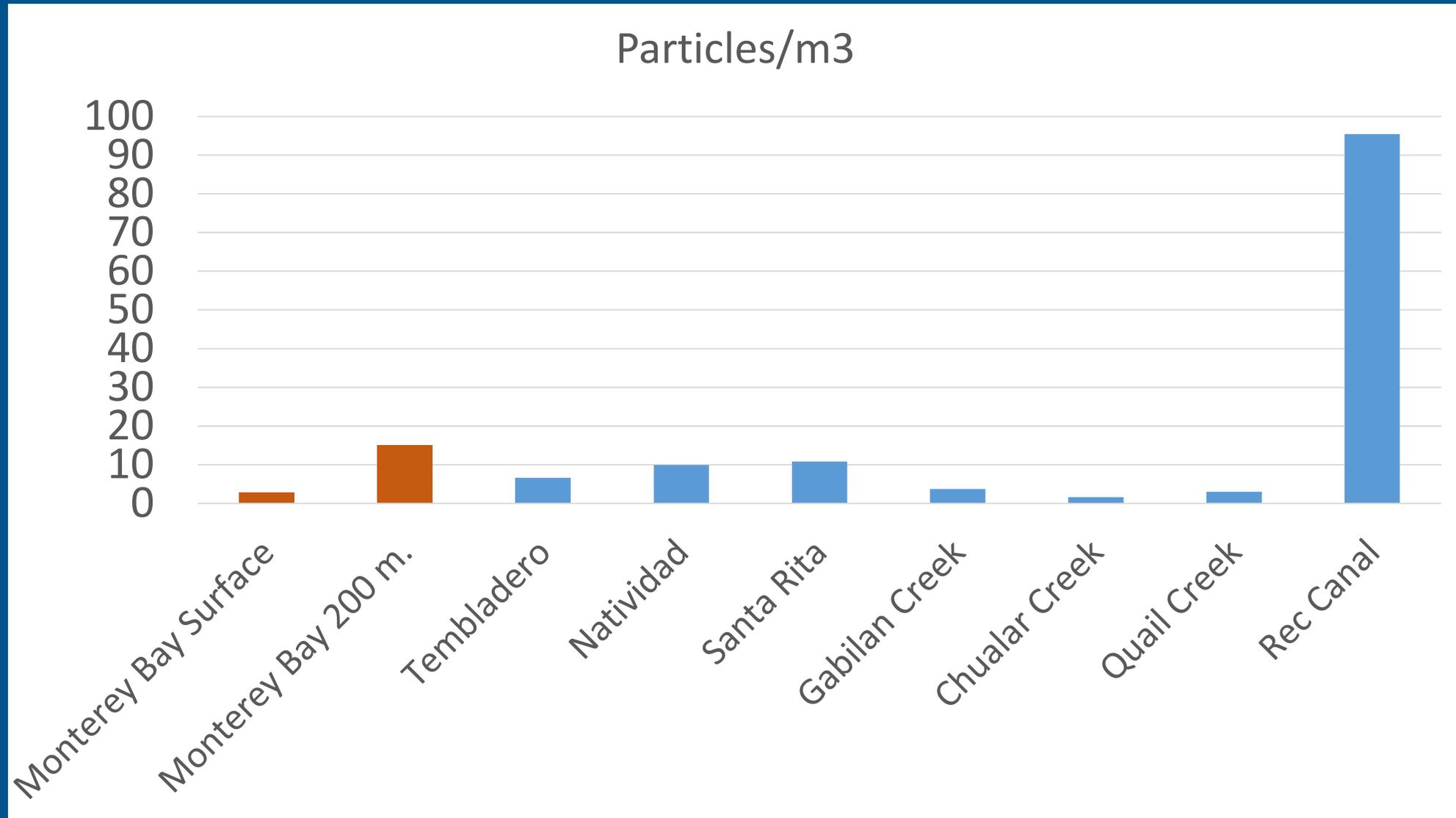
Total Ag Plastic Count on Banks of 9 Streams



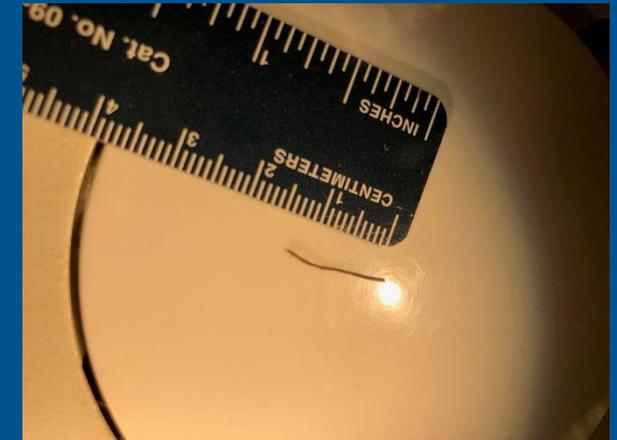
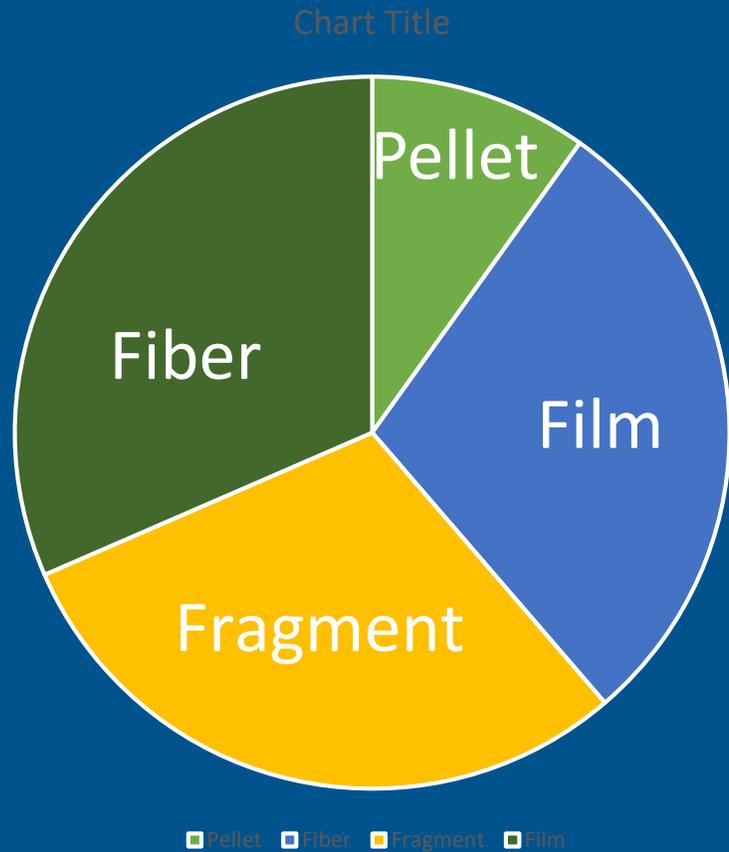
- Strapping tape
- Ag. equipment fragmentation
- Produce Packaging
- Thick plastic fragment
- Drip tape/Irrigation Tubing
- Plastic Mulch
- Personal Protective Equipment
- Rubber Bands

Strapping tape	70
Drip tape/Irrigation Tubing	17
Ag. equipment fragmentation	3
Plastic Mulch	433
Produce Packaging	7
Personal Protective Equipment	11
Thick plastic fragment	19
Rubber Bands	23

Microplastic Density in Streams compared to Monterey Bay



Salinas Streams Microplastic Characteristics

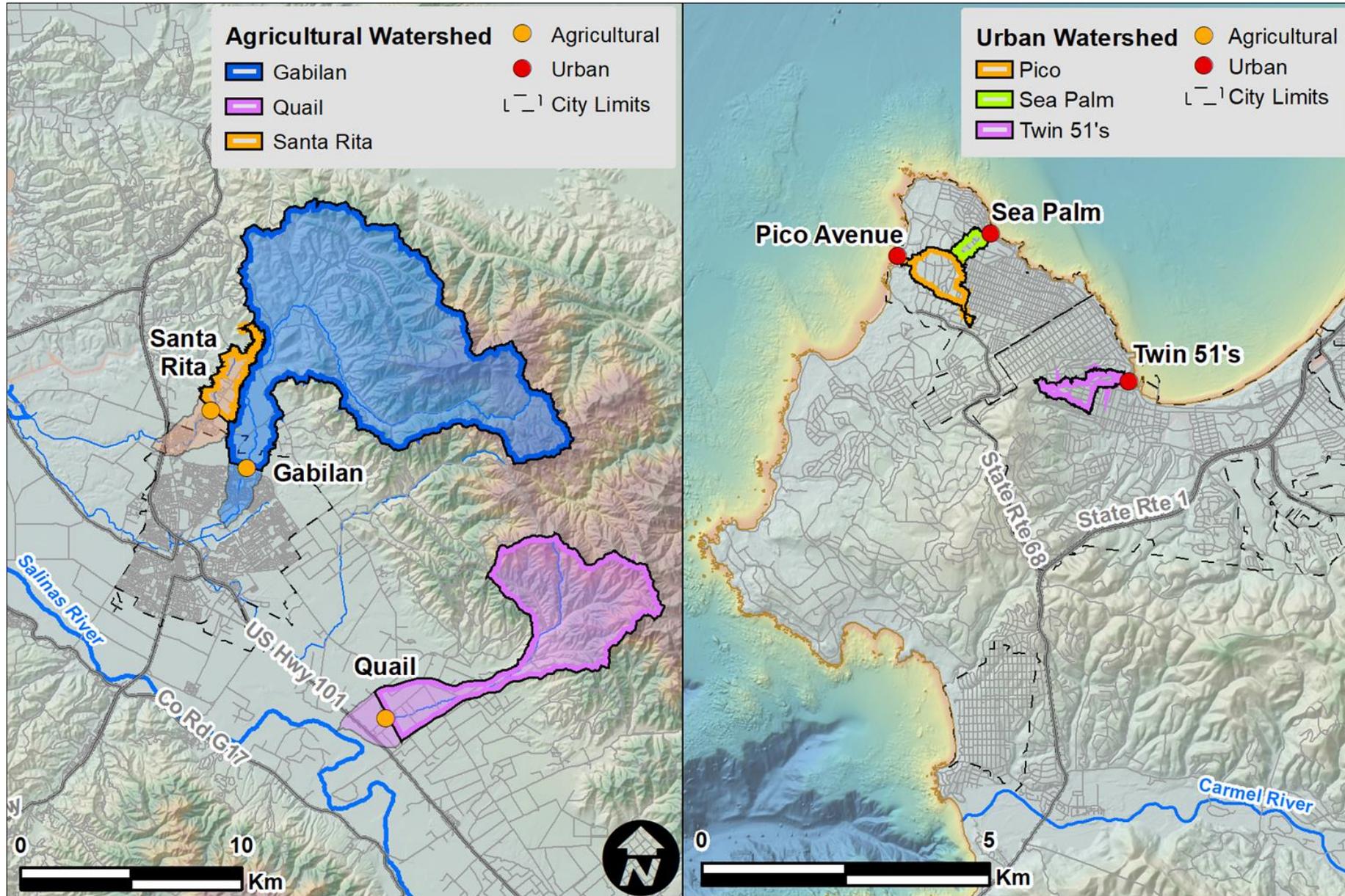


Microplastic Comparison to Other Water Bodies

Water Body	Particles / cubic meter
Monterey Bay surface to 1000 meters	2.9-15
Great Lakes	0.3
Tributaries to Great Lakes	32
Los Angeles River	418
SF Bay	0.3 - 65
Marine Sanctuaries near SF	0 – 0.5
Urban Tributaries to SF	0 – 0.03
Salinas Creeks and Rivers	1.6 – 95.4

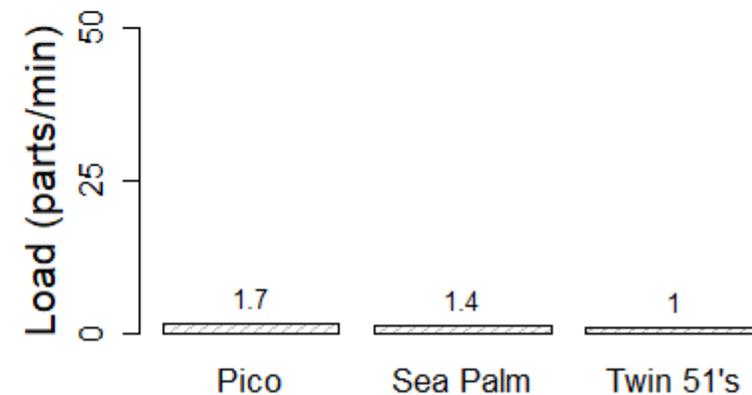
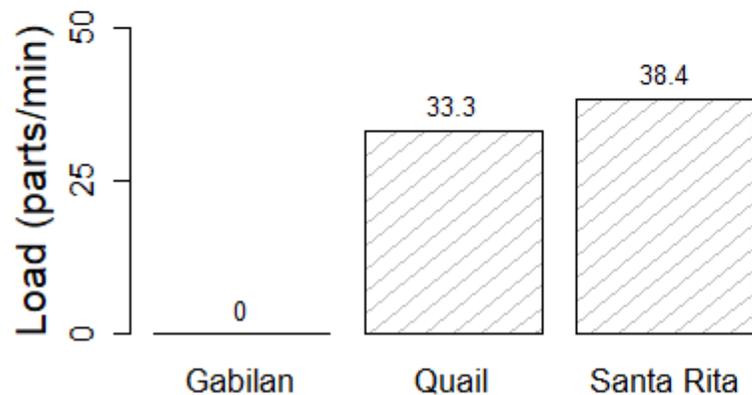
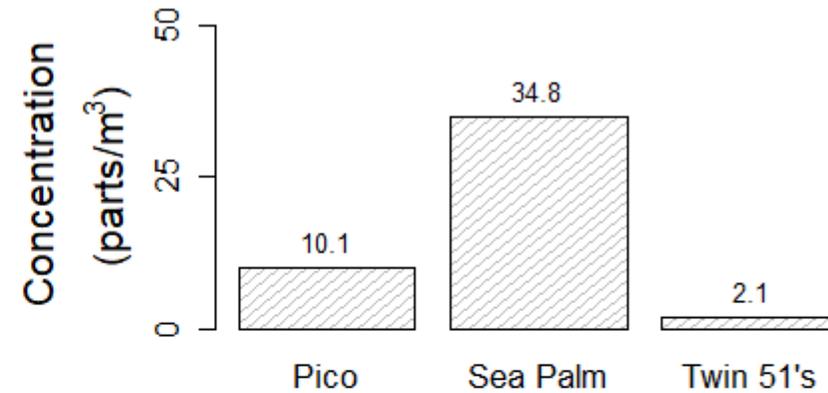
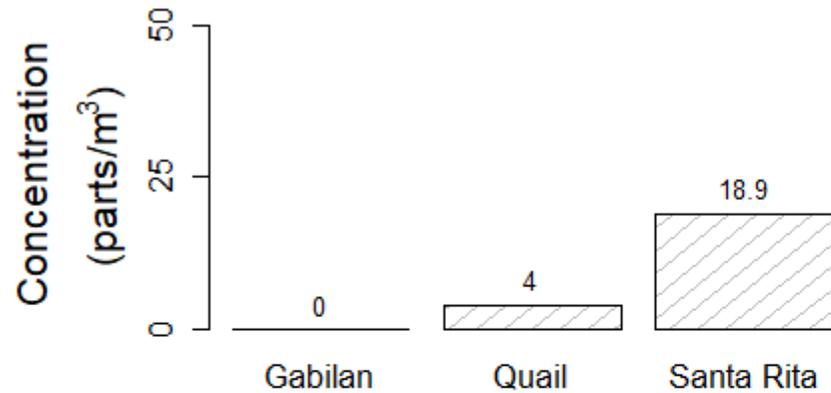


Comparing Ag vs Urban Dominated Sites

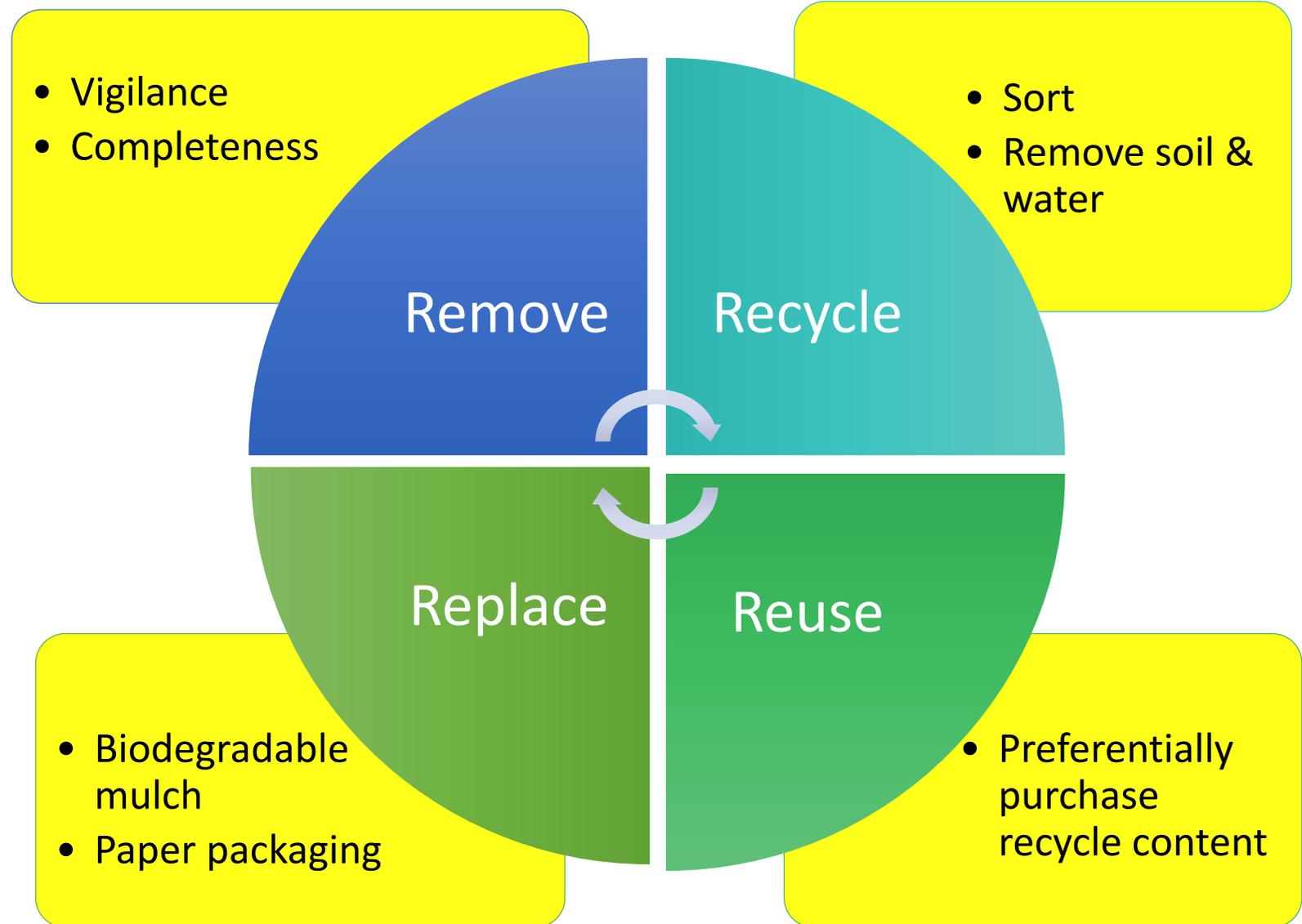


Results- Concentration and loads of plastic

- Concentration of MPs higher at urban site
- Load was greater at ag sites due to greater flows and generally higher volume of water samples.



Solutions



Use of Plastic in Agriculture



- ❖ US agriculture uses ~1 billion pounds of plastics annually*
- ❖ Mulch use in North America was 60,000 tons in 2007
- ❖ Each plastic type must be considered separately for the best way to responsibly manage it. And this is changing all the time.

*Estimates provided by G. Jones, SWIX

Identification of Best Alternative for Each Plastic Used and How to Evolve

Plastic Use	Current Best Alternative	Evolution
Plastic Mulch	Complete Removal and Disposal	Biodegradable Mulch
Drip Irrigation Tubing	Recycling to Encore or to Supplier: Netafim or Delta	Complete Circular Use from Product to Product
Ditch Liner	Permanent piping or vegetated ditch	Address food safety issues of vegetation
Hoop Houses	Reuse plastic for other purposes after taken down	??
Package Strapping Tape	Removal from the Field and Disposal	Standardize, Cut and Recycle

Problems with PE Mulch Recycling



Dirt

- ❖ Dirt adheres to the mulch- 50% by weight is dirt
- ❖ Dirt is expensive to haul
- ❖ Dirt can abrade the recycling equipment
- ❖ Once removed, the dirt needs to be disposed

REUSE

- ❖ There are many blends of resins in PE plastic mulch, eg color, layers, additives, making it difficult to find a product for reuse
- ❖ When oil prices go down, this hurts the recycled plastic market
- ❖ Most people do not PREFERENTIALLY purchase recycled product.



Encore Recycling in Salinas cannot economically recycle mulch

PE Mulch Removal and Disposal

Current responsible disposal is to the regional waste management facility.



Complete removal is difficult due to breakage



Abandoned plastic is extremely costly to remove



Vigilance and Completeness of Removal IS Important



Washington State University estimates that 10% of PE mulch is left in the field.

Technology to remove plastic can save man hours and increase retrieval rate.

Following up with Field personnel can increase Completeness.

Biodegradable Alternative to PE Mulch

Biodegradable mulch (BDM) can be a sustainable alternative to polyethylene (PE) mulch:

- ❖ Provides crop production benefits comparable to PE mulch:
 - Weed control
 - Moisture retention
 - Soil temperature modification
 - Early harvest
 - Increase crop yield and quality
- ❖ Designed to be tilled into the soil after use, eliminating waste and disposal challenges
- ❖ **Note:** BDMs should not go into recycling facilities, they will contaminate recycle



Trials Are Needed in California for Biodegradable Mulch



- Need to overcome current misperceptions about Biodegradable mulch, eg previous false marketing of photo-degradable mulch.
- There is no organically certified BDM
- Need to learn application differences and how to place on field, stretch, width and equipment setting.
- Need to collect yield, labor and degradation rate in CA berry production.
- Planning for Field Trials starting this July with Mark Bolda UCCE, and WA State Researchers.

Drip Tape is Recyclable



- Innovative Companies are recycling drip tape into other products and in some cases back into drip tubing.
- The recycled content is still very low and will increase with time.
- Complete retrieval from the field is still an issue.
- Drip Tubing cannot be recycled at the same facilities
- Single Use Drip tape is becoming popular, and may be the best alternative
- <https://www.youtube.com/watch?v=rFcudzLmnCg>

Animal Exclusion Fencing



Exclusion fencing can break apart with sun and wind.

The right weight and installation guidelines need to be determined.

Recyclable?

Strapping Tape for Boxes



- Strapping tape comes in many colors and is made from different materials, making recycling a challenge.
- There may be a market for recycling strapping tape, but it has to be cut and shipped currently.
- This needs investigation, as it is one of the most predominant plastic types found on some stream banks.

Hoop House Plastic



Ditch Liner



Issues include breakage and also burial into the ground, making retrieval difficult to impossible.

Vegetated Ditches are a possible solution, but food safety concerns need to be addressed.

In some cases a permanent pipe could be installed, however this is expensive

Solutions to Move Forward

Policy Solutions

Consumer Choices

Sustainability Indices

Collaboration

Caring Enough to Make it a Priority



Our Work Going Forward

- Look for opportunities to fund my continued work on plastic solutions for agriculture.
- Participate in Biodegradable Mulch Collaboration and Field Trials. Develop ways to communicate outcomes with Growers and Ag Professionals.
- Collaborate with CSUMB and MLML on continued monitoring, fate, transport and degradation of plastic
- Seek solutions for each plastic type and find ways to communicate to the ag community.

