It’s the most wonderful time of the year: jellyfish season!

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What is it?

Why so many?

Where are they coming from?

What is it?

Villa Gesell, Argentina. Summer 1980
“Jellyfish”

- A diverse group of organisms with jelly-like tissues that contain a high percentage of water (95%-99%).
Typical jellyfish anatomy

- Bell (umbrella)
- Stomach
- Oral arms
- Tentacles
SCYPHOZOA ("True jellyfish")
- ~200 species (eight species in the GoM)
- Exclusively marine
- Oral arms
- Large (> 5 inches bell diameter)
HYDROZOA
• ~ 800 species (90 species in the GoM)
• Mostly marine
• Relatively small (<3 inches bell diameter)
• Without oral arms

• Solitary

• Colonial
CUBOZOA ("box jellyfish")
- ~ 50 species (two species in the GoM)
- "Squared-shape" body
- Medium size (<7 in. bell diameter)
- Marine; sub-tropical and tropical
- Highly venomous

Sea wasp (Chironex fleckeri)

- Complex eyes
Jellyfish blooms
Negative effects on tourism by stinging swimmers
Negative effects on power generation by clogging intake screens of power plants

Hadera, Israel 2011

100 tones of *Rhopilema nomadica* removed

USS Ronald Reagan
Negative effects on commercial fishing by clogging fishing gear

Namibia

Argentina

Japan
Negative effects on commercial fishing by decreasing fish production.
Energy flow

More  Less

WHEN MENHADENDOMINATE
Menhaden provide an efficient pathway for energy to flow from plankton to large predators.

WHEN JELLYFISH DOMINATE
Fishing could free jellyfish from competition. They could eat more plankton, diverting energy from larger predators.

Reduced production of new biomass

Less energy to predators

Jellyfish compete with menhaden
**Jellyfish life cycle**

**Sexual, pelagic phase**

- Ephyra
  - 1 mm

- Medusa (♂, ♀)
  - 100 mm

- Planula larvae
  - 1 mm

**Asexual, benthic phase**

- Strobilation

- Polyp
  - 2 mm

- **GENERAL INTRODUCTION**

- Planula larvae

- Medusa (♂, ♀)

- Ephyra
  - 1 mm
Ecological benefits of jellyfish
• Jellyfish provide refuge for juvenile fish in open waters.
• Positive effect on fish recruitment.
- Jellyfish represents a food source for several adult fish.
- Jellyfish represents a food source for several adult seabirds.
Jellyfish are the main food source of critically endangered sea turtles.

Leatherback turtle

- Jellyfish are the main food source of critically endangered sea turtles.
Jellyfish represents a food source for several invertebrates in shallow habitats.

Spider crab and cannonball jellyfish

Carnivorous snails and mushroom jellyfish

Crab and mushroom jellyfish

Crab and moon jellyfish
- Jellyfish represents a food source for deep marine species

Lobster feeding on jellyfish carcasses (Dunlop et al., 2017)

Hagfish, crabs, and sea stars feeding on jellyfish carcasses (Dunlop et al., 2018)
Societal benefits of jellyfish
• Jellyfish represents a food source for humans!!

• 18 countries are catching jellyfish for food, including the USA!

• Jellyfish fisheries around the world. Circles indicate magnitude of catch in tones.
• Jellyfish harvesting
• Jellyfish processing

Jellyfish desalination

Delicious jellyfish salad and jellyfish noodles!

Dried up jellyfish, ready to be exported

- No fat
- Low carbs
- High protein (~70%)
Jellyfish are valuable sources of revenue
- Jellyfish exhibits
Jellyfish are valuable sources of revenue
• Ecotourism: Jellyfish Lake (Palau)
Jellyfish as source of novel compounds

One of the greatest benefits that jellyfish have had to society: discovery and development of the green fluorescent protein and other fluorescent proteins (FP)

Aquorea jellyfish
Jellyfish in the Gulf of Mexico
**Comb jellies**

**Mnemiopsis leidyi**
- Distinguished features: Transparent, elongated body with “lobes”; semitransparent rows of “combs” running the length of the body.
- Distribution: Along the entire Gulf coast
- Period of occurrence: Year round with peaks in spring and summer
- Size: up to 4 in
- Sting: **no sting**

**Beroe ovata**
- Distinguished features: Barrel shaped; reddish-brown to orange with rows of “combs” running the length of the body.
- Distribution: Along the entire Gulf coast
- Period of occurrence: Year round
- Size: up to 8 in
- Sting: **no sting**
Moon jellyfish *Aurelia* spp.

- **Distinguished features:** pink, flat umbrella, horse-shoe shaped stomachs, short tentacles
- **Distribution:** Along the entire Gulf coast
- **Period of occurrence:** Fall
- **Size:** up to 19 in
- **Sting:** very mild
Aurelia sp. 9  

Aurelia c.f. sp. 2

Chiaverano et al. (2016)
Aurelia blooms in the Gulf of Mexico

- Aurelia is the most abundant jellyfish in the Gulf of Mexico.
Time-series of Aurelia (moon jellyfish) in the Gulf of Mexico

Robinson and Graham (2013)
Sub-optimal conditions: small polyps; 15 new polyps per parent polyp

Optimal conditions: Large polyps; 50 new polyps produced per parent polyp

Chiaverano et al. (2017)
**Optimal conditions:**
8 jellyfish per polyp

**Sub-optimal conditions**
3 jellyfish per polyp

One single polyp produced 400 jellyfish

One single polyp produced 45 jellyfish

Chiaverano et al. (2017)
Sea nettle *Chrysaora chesapeakei*.

- Distinguished features: white/cream umbrella, brown/white streaks from the center; long tentacles and oral arms
- Distribution: Coastal northern Gulf of Mexico
- Period of occurrence: Summer
- Size: up to 6 in
- Sting: moderate
Time-series of *Chrysaora* (see nettle) in the Gulf of Mexico
Portuguese man-o-war (**Physalia physalis**)

- **Distinguished features:** Purplish-blue, gas-filled floating sac with long red, purple or blue tentacles.
- **Distribution:** Along the entire Gulf coast
- **Period of occurrence:** Fall-winter
- **Size:** up to 12 in; tentacles up to 6 feet
- **Sting:** highly venomous
By-the-wind sailor (*Velella velella*)

- Distinguished features: Bluish/purple with a flat oval float; a triangular sail projects vertically; short tentacles hang down from float.
- Distribution: Along the entire Gulf coast
- Period of occurrence: Spring-summer
- Size: up to 3 in.
- Sting: **no sting**

Blue button (*Porpita porpita*)

- Distinguished features: Button-shaped float with short tentacles beneath; float has grooves radiating from the center.
- Distribution: Along the entire Gulf coast
- Period of occurrence: Spring-summer
- Size: up to 2 in;
- Sting: **no sting**
Cannonball jellyfish (*Stomolophus meleagris*)

- **Distinguished features**: Rounded, “semi spherical”, rigid bell; milky color, sometimes with reddish-brown pattern along the bell margin; no tentacles, oral arm rigid
- **Distribution**: Along the entire Gulf coast
- **Period of occurrence**: Summer-Fall
- **Size**: up to 12 in.
- **Sting**: very mild to no sting
Crystal jellyfish (*Aequorea aequorea*)

- **Distinguished features:** Flat, solid saucer-shaped bell; radial canals that feel like ridges; “magnifying lens” center, very fine tentacles.
- **Distribution:** Along the entire Gulf coast
- **Period of occurrence:** Spring-summer
- **Size:** up to 10 in.
- **Sting:** very mild to no sting
Mushroom jellyfish (Rhopilema verrilli)

- Distinguished features: Mushroom-shaped, whitish bell; no tentacles, 8 oral arms; fingerlike transparent extensions below oral arms.
- Distribution: Northern Gulf of Mexico
- Period of occurrence: Winter
- Size: up to 20 in.
- Sting: mild

Lion’s mane jellyfish (Cyanea capillata)

- Distinguished features: Saucer-shaped bell, eight lobes along bell edge, white to pink, often with thin pairs of red-brown radial stripes; more than 150 very long stinging tentacles.
- Distribution: Northern Gulf of Mexico
- Period of occurrence: Winter
- Size: 12 in (can reach up to 6 feet)
- Sting: strong
Pink meanie jellyfish (*Drymonema dalmatatinum*)

- **Distinguished features:** Similar to the lion’s mane; bell with central “dome”; pink to yellow-white; 150 long tentacles; dense ribbon-like oral arms.
- **Distribution:** northern Gulf of Mexico
- **Period of occurrence:** Fall
- **Size:** up to 3 feet; tentacles up to 100 feet.
- **Sting:** strong
Upside-down jellyfish (*Cassiopea spp.*)

- **Distinguished features:** Flattened bell, and a widespread array of finely branched oral arms; no tentacles; associated with the bottom (upside-down); highly variable in color.
- **Distribution:** Shallow southeast Gulf of Mexico (Florida Keys)
- **Period of occurrence:** Year round
- **Size:** Up to 12 inches
- **Sting:** Mild to moderate
Box jellyfish (*Chiropsalmus quadrumanus*)

- Distinguished features: Translucent dome-shaped, “square” bell with four distinct sides; seven to nine finger-like tentacles coming from each side.
- Distribution: coastal southeastern Gulf of Mexico (west Florida)
- Period of occurrence: Summer-Fall
- Size: up to 6 inches; tentacles up to 10 feet.
- Sting: highly venomous
Box jellyfish (*Tamoya haplonema*)

- **Distinguished features**: Translucent elongate, “square” bell with four distinct sides; only one, thick tentacle comes from each side.
- **Distribution**: Coastal southeastern Gulf of Mexico (west Florida)
- **Period of occurrence**: Year round
- **Size**: Up to 7 inches; tentacles up to 10 feet.
- **Sting**: Highly venomous
Questions?
Potential drivers jellyfish blooms

- **Overfishing** (Lynam et al. 2006, Pauly et al. 2009)
- **Eutrophication** (Arai 2001, Stoner et al. 2011)
- **Introduction of non-indigenous species** (Graham & Bayha 2007)
- **Habitat modification** (Purcell et al. 2007, Lo et al. 2008, Duarte et al. 2012)
- **Anthropogenic climate change** (Purcell 2012)
- **Natural climate variability** (Purcell 2005, Brodeur et al. 2008, Chiaverano et al. 2013, Robinson & Graham 2013)