Design of an eastern tropical Pacific (ETP) dolphin survey

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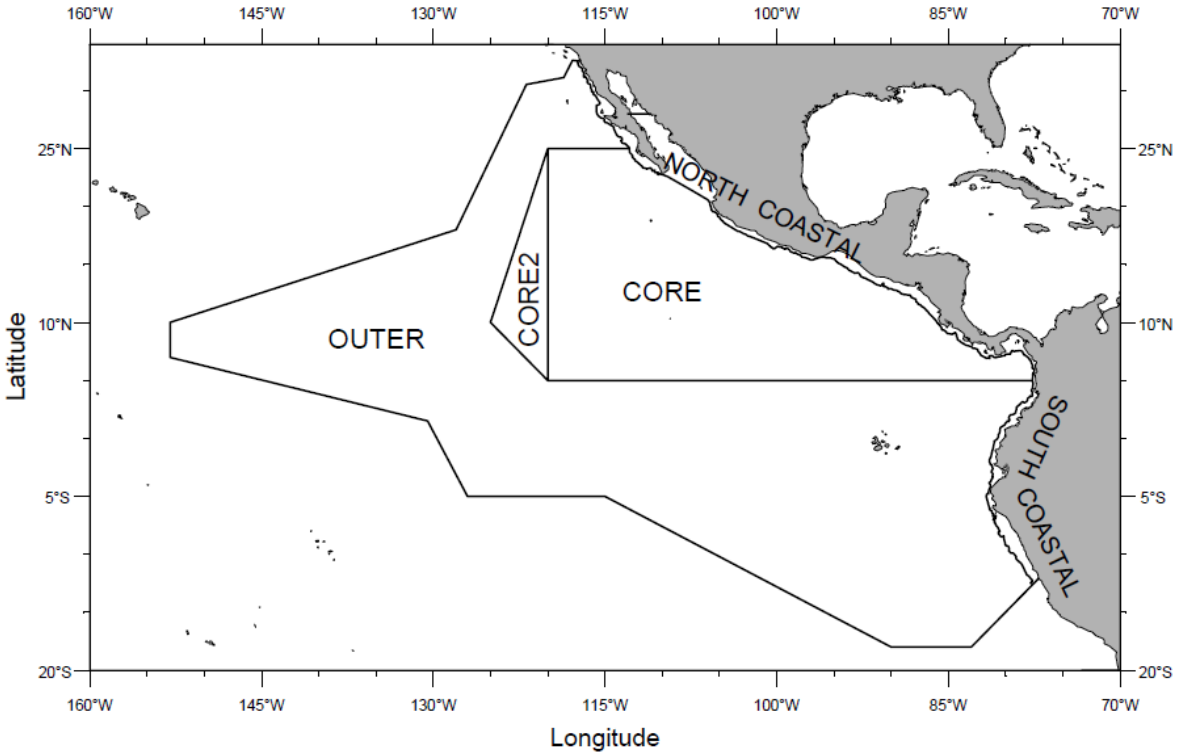
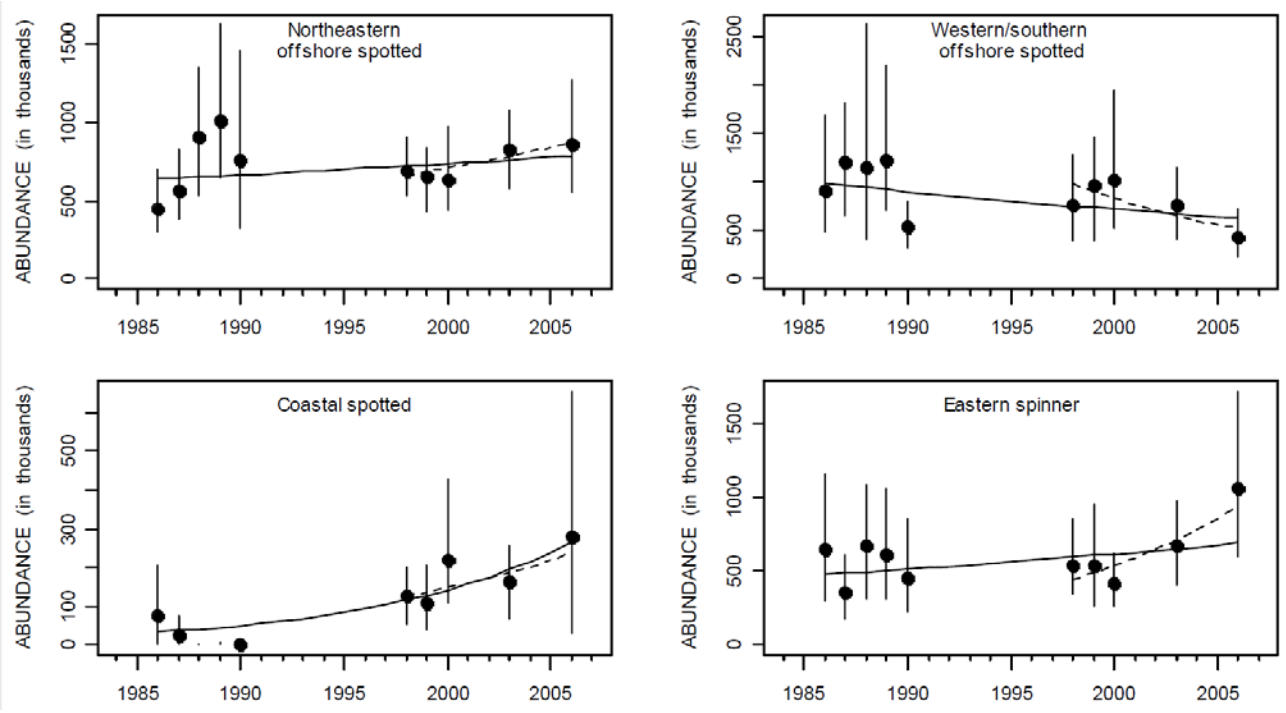
Previous ETP dolphin surveys were conducted by the National Marine Fisheries Service (NMFS)

Recent survey strata and abundance estimates:



Strata for the STAR06 cruise.



Abundance estimates for 10 surveys 1986 – 2006.
Vertical lines: bootstrap 95% confidence intervals.
Solid lines: fit of a model of exponential change from 1986- 2006, dashed lines from 1998-2006.

Gerrodette et al. 2008

Issues for next survey

- Potential use of tuna vessels: comparable to previous surveys?

- Barlow (2015): trackline detection probability g(0) < 1 for Beaufort > 0

Estimated trackline detection probability g(0) relative to Beaufort 0 (Barlow 2015).
Coefficients of variation (CV) from jackknife method are in italics.

	Number of Sightings used for estimates	Beaufort Sea State						
Species		0	1	2	3	4	5	6
Spinner dolphin (Stenella longirostris)	969	1	0.73	0.54	0.39	0.29	0.21	0.16
			0.03	*0.06*	*0.09*	*0.13*	*0.16*	*0.19*
Spotted dolphin (St. attenuata)	1,653	1	0.73	0.53	0.39	0.28	0.21	0.15
			0.03	*0.06*	*0.09*	*0.12*	*0.15*	*0.18*

Objectives for next ETP survey

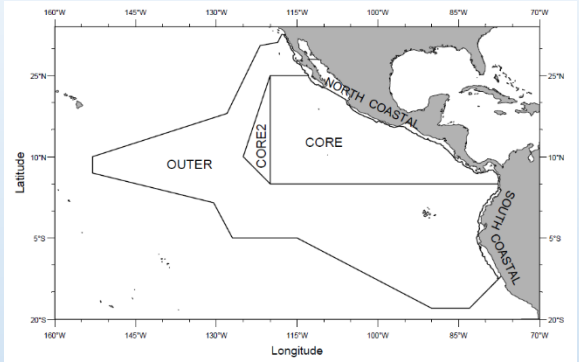
1. Estimate *relative* abundance of priority stocks such that the estimates are comparable as far as possible with past estimates from NMFS surveys

2. Estimate *absolute* abundance of the priority stocks

Survey area and priority stocks

Survey area:

the area with strata as for the 2006 survey

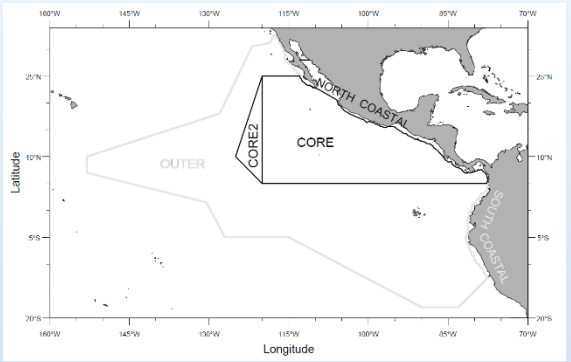


A. 10 stocks for which Gerrodette et al. (2008) gave abundance estimates, all of which have suffered at least some mortality in the ETP purse seine fishery for tuna

Species	Scientific Name	Stock
Spotted dolphin	Stenella attenuata	northeastern offshore
Spotted dolphin	St. attenuata	western/southern offshore
Spotted dolphin	St. attenuata graffmani	coastal
Spinner dolphin	St. longirostris orientalis	eastern
Spinner dolphin	St. longirostris	whitebelly
Striped dolphin	St. coeruleoalba	
Rough-toothed dolphin	Steno bredanensis	
Short-beaked common dolphin	Delphinus delphis	northern, central and southern combined
Bottlenose dolphin	Tursiops truncatus	
Risso's dolphin	Grampus griseus	

Survey area:

core, core2 and N. coastal stratum (just the strata where these stocks occur)



B. Main stocks listed as 'depleted' by the MMPA, https://www.mmc.gov/priority-topics/species-of-concern/status-of-marine-mammal-species-and-populations/)

Species	Scientific Name	Stock
Spotted dolphin	Stenella attenuata	northeastern offshore
Spinner dolphin	St. longirostris orientalis	eastern

Drones for the next ETP survey

Address the g(0) issue and vessel calibration

- Monitor the area in front of the vessel for mark-recapture distance sampling methods (Borchers 2012)

School size calibration

- High resolution imagery

Alternatives to drones

- Fixed-wing aircraft
- Helicopters

Advantages of drones

- Safer
- Potentially higher Beaufort sea states
- Longer hours of operation

Flexrotor operated by Precision Aviation. Source: https://www.flyprecision.com

HQ-55 operated by Latitude Engineering. Source: https://latitudeengineering.com

Sequence of events

- Trial survey in July - December 2019
- Post-trial assessments
  - Potential differences between vessels?
  - g(0) estimates for vessels
  - Length of drone operations for each vessel
- Main survey in July - December 2020

Trial survey

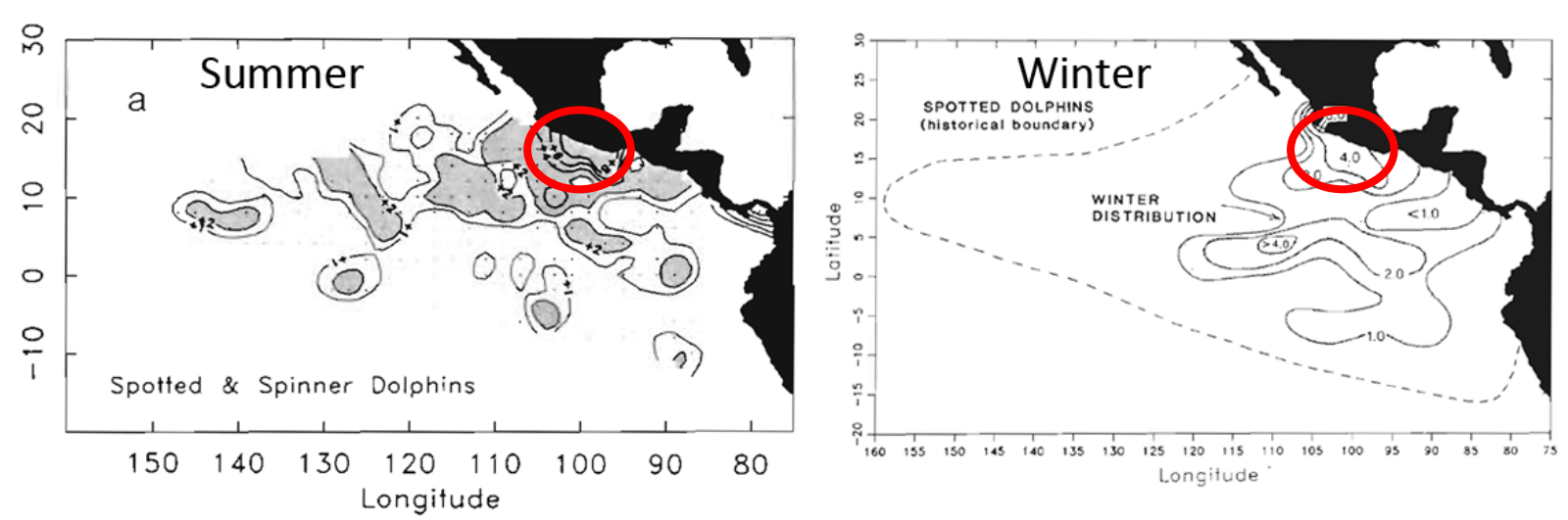
Rationale

- Pilot survey
- Vessel calibration *
- Testing utility of drones for
  - Assessing g(0) issue **
  - School size calibration

Length

- 30 days if vessel calibration
  - 1 tuna + 1 research vessel
- 14 days if no vessel calibration
  - 1 research vessel

Study area: highest expected encounter rates

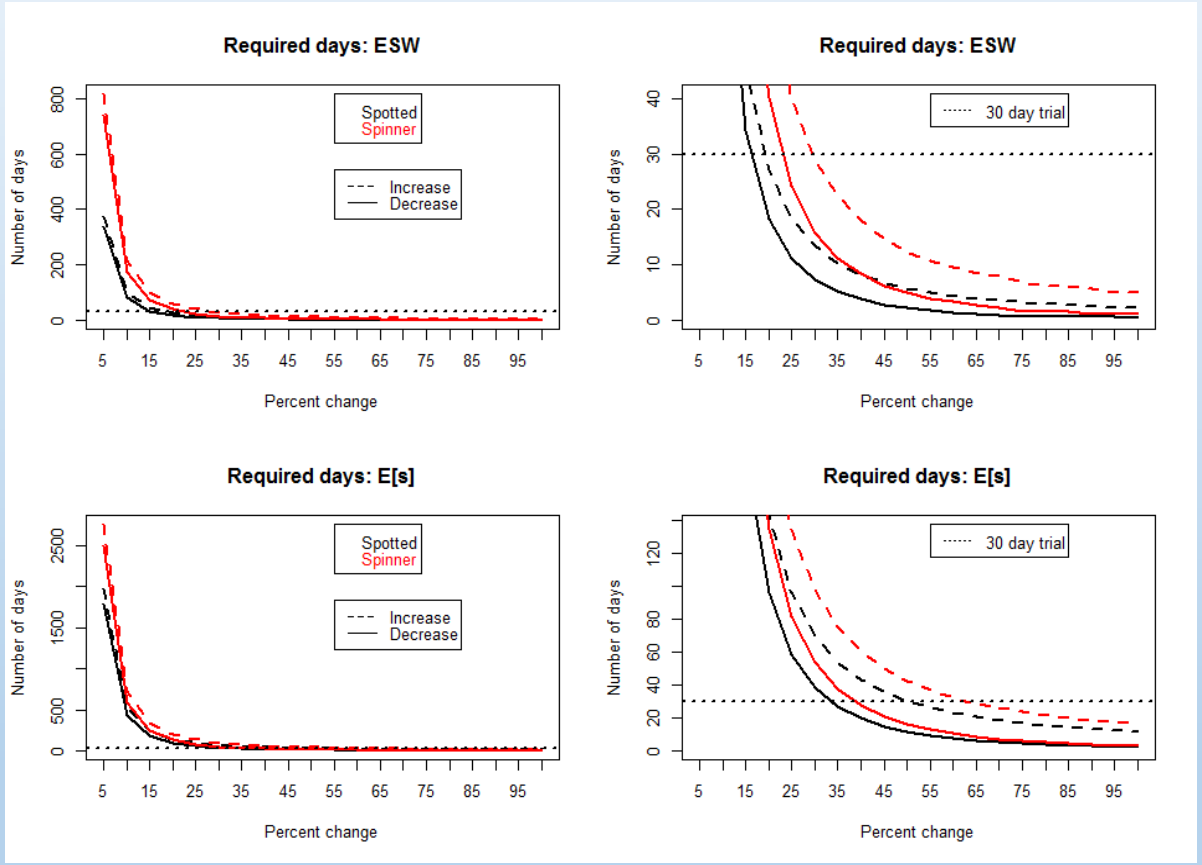


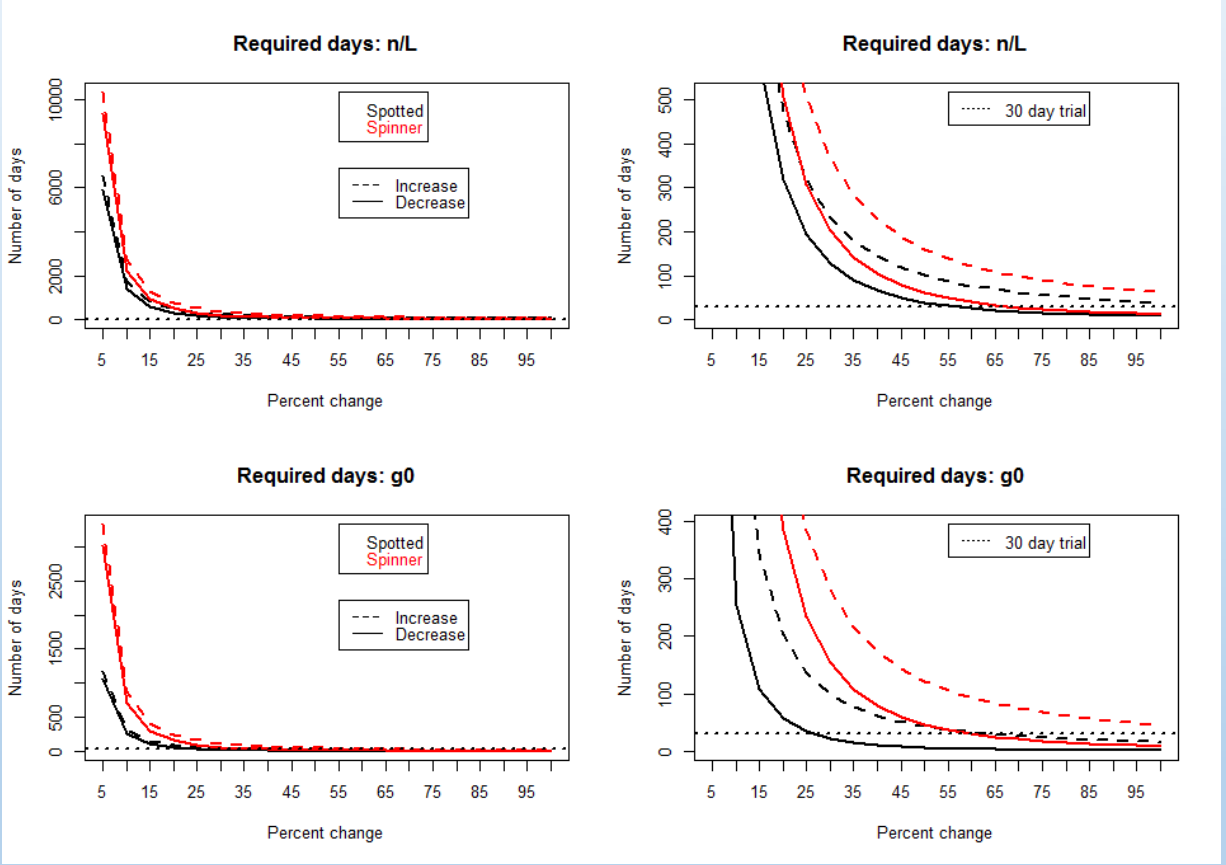
Summer and winter distributions of spotted and spinner dolphins in the ETP as contours of encounter rates per 185 km searched, Reilly 1990).

* If tuna vessels are involved in main survey

** If objective 2 and/or if tuna vessels are involved in main survey

How many survey days for vessel calibration?





Estimated survey days required to detect a significant percent change in the effective strip width (ESW), expected school size *E[s]*, encounter rate *n/L* and trackline detection probability g(0) between a research and tuna vessel (right plots are zoomed in).
Parameter estimates used for this assessment were obtained from Gerrodette et al. (2008), Barlow (2015) and Hammond et al. (2017).

A 30 day trial

We expect we can detect a change in

	Effective strip half width	School size
Spotted dolphins	>20%	>50%
Spinner dolphins	>30%	>60%

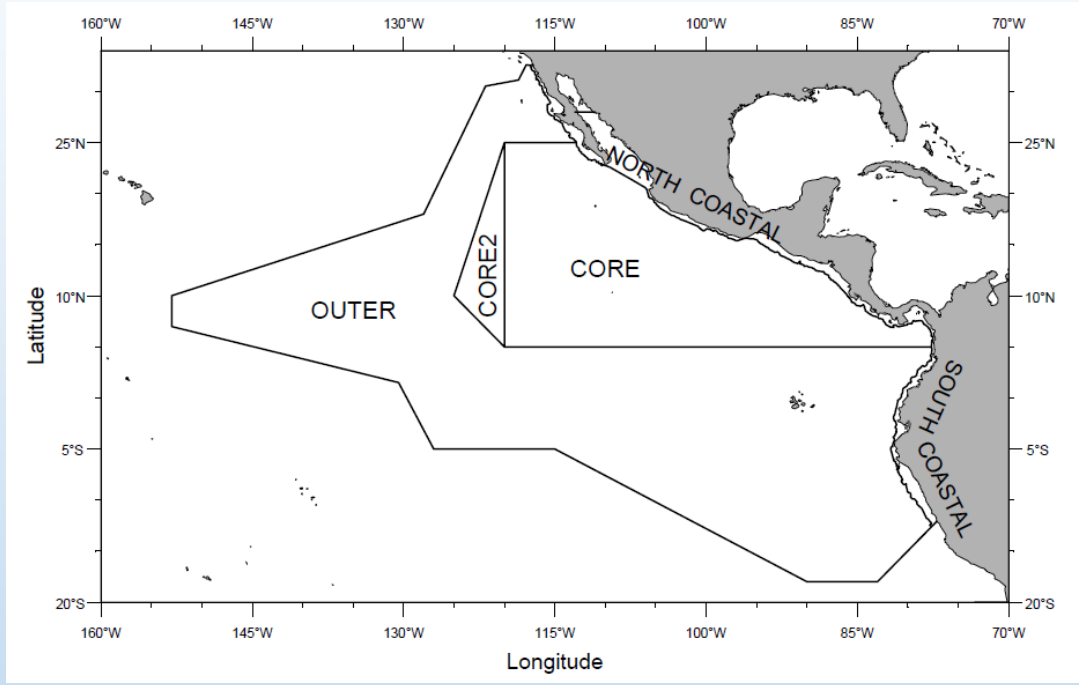
We expect we can detect a decrease in

	Encounter rate	Trackline detection probability g(0)
Spotted dolphins	>55%	>30%
Spinner dolphins	>70%	>45%

Main survey: scheme 1

- Address objectives 1 and 2
  1. Comparable estimates of abundance
  2. Absolute estimates of abundance

- Priority species A
  - 10 stocks from Gerrodette et al. (2008)



Study area and strata as in STAR06

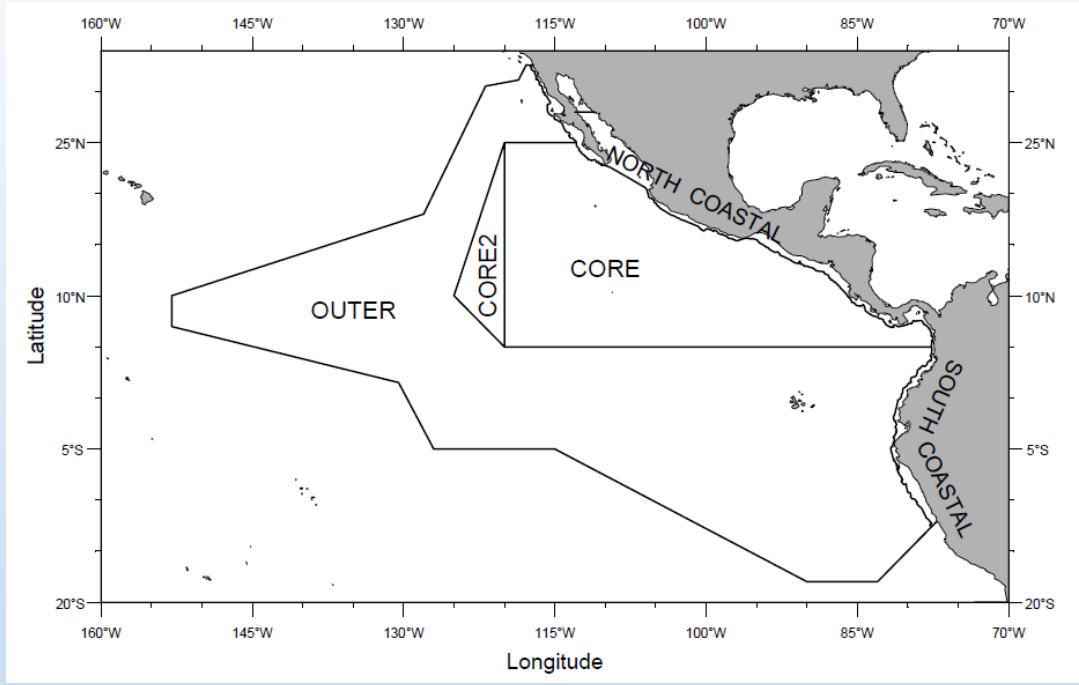
- Two vessels, 120 sea-days each
- One or two drones
- Same strata with proportional effort allocation as STAR06

Main survey: scheme 2

- Address objective 1
  1. Comparable estimates of abundance

- Priority species A
  - 10 stocks from Gerrodette et al. (2008)

- Two vessels, 120 sea-days each
- One or two drones
- Same strata with proportional effort allocation as STAR06



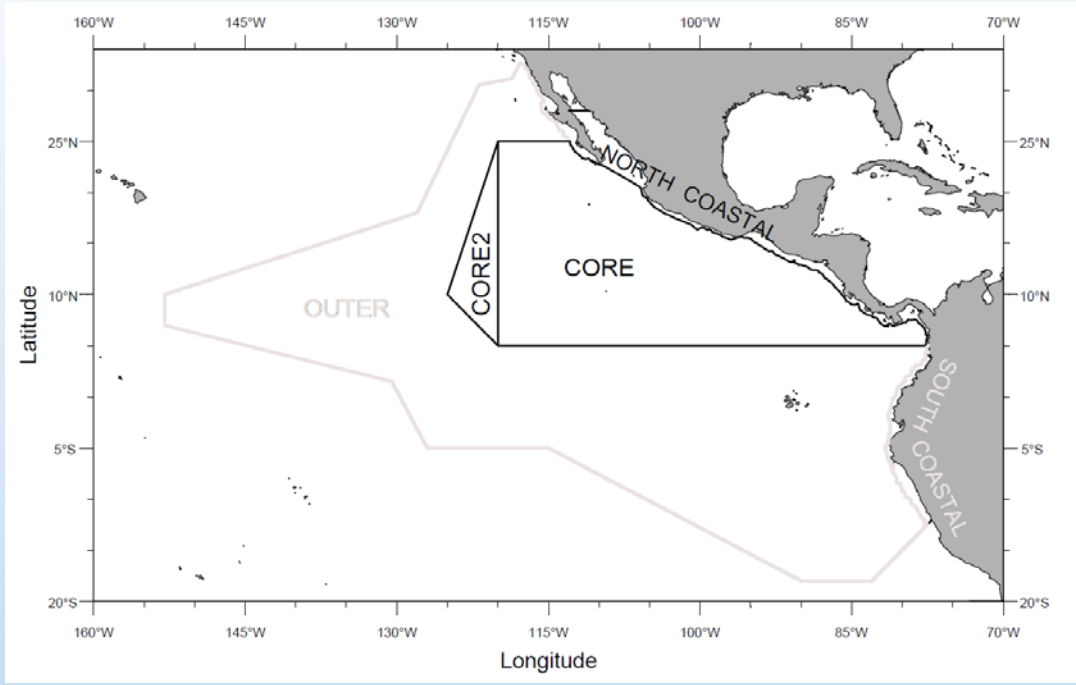
Study area and strata as in STAR06

Main survey: scheme 3

- Address objectives 1 and 2
  1. Comparable estimates of abundance
  2. Absolute estimates of abundance

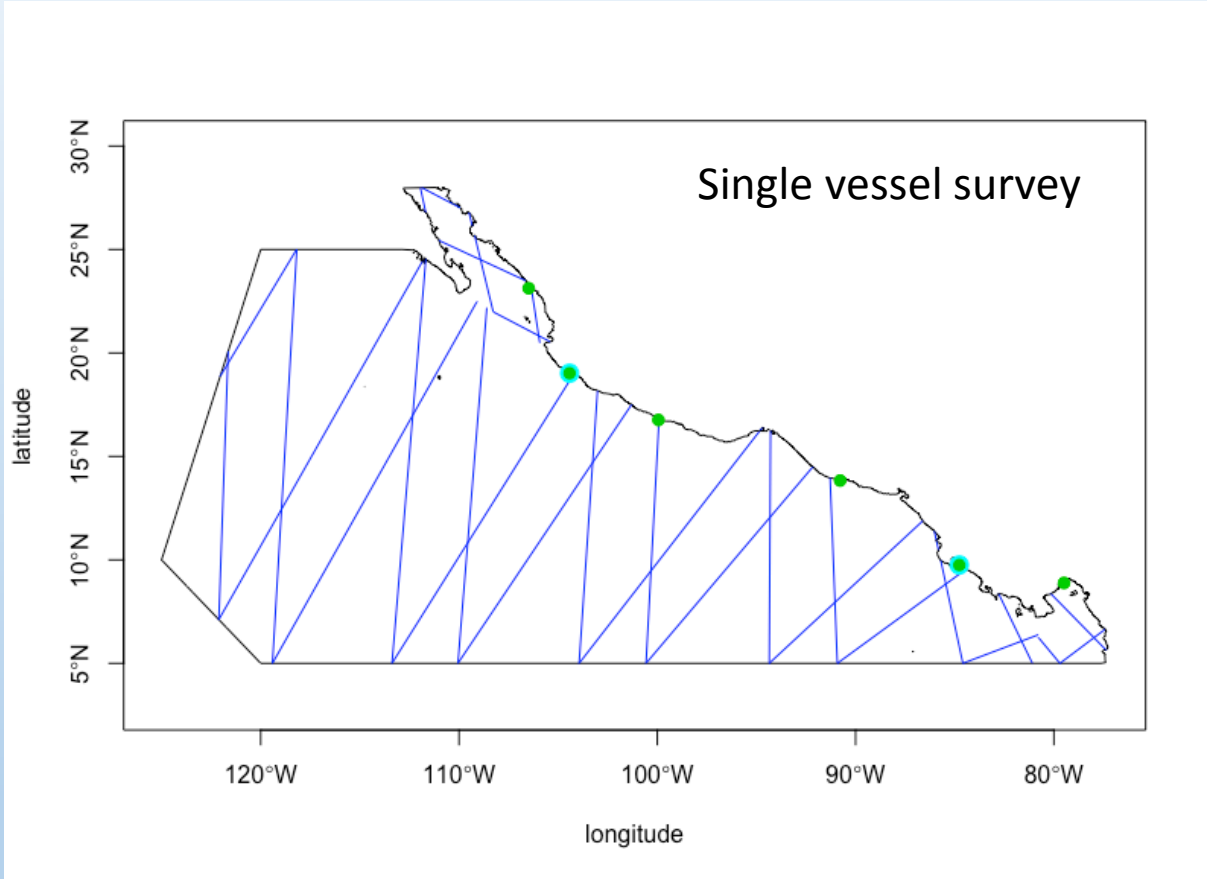
- Priority species B
  - 2 main stocks

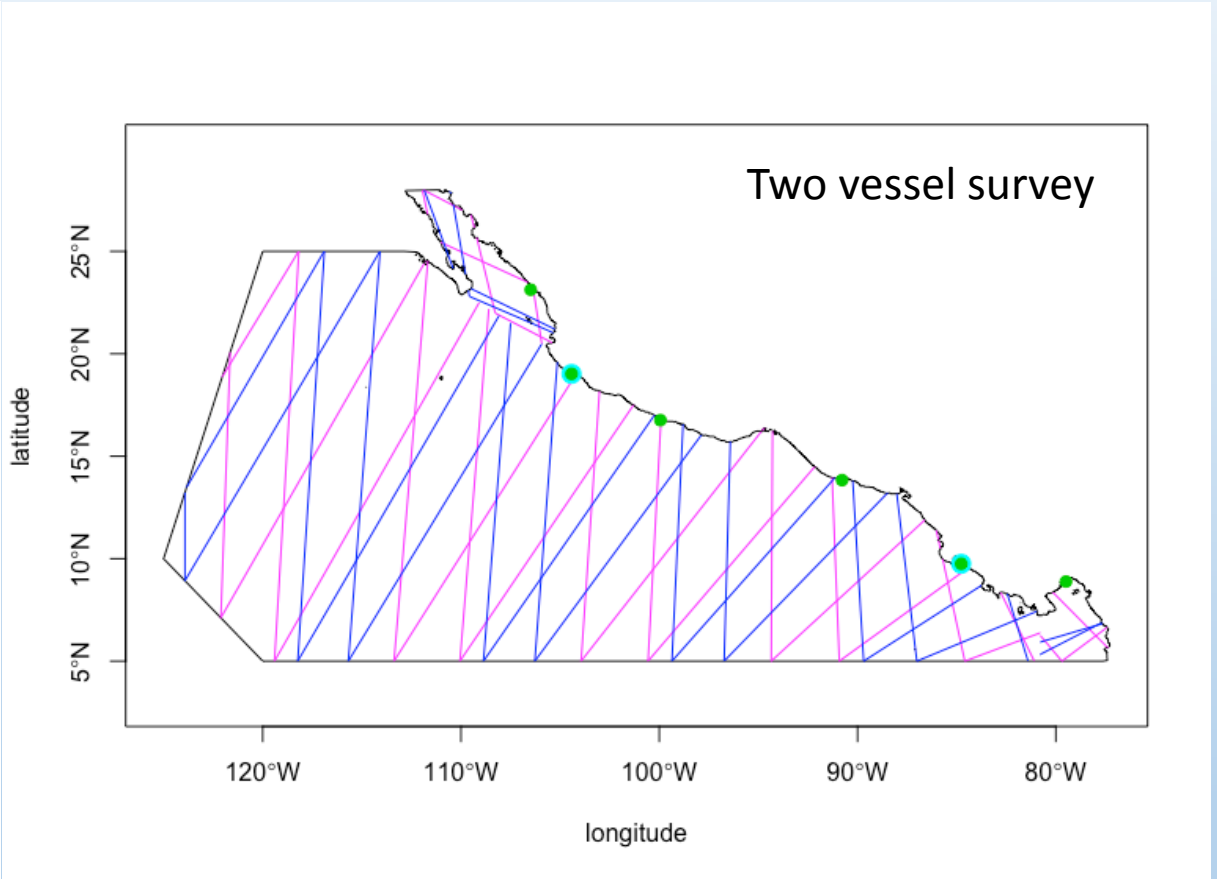
- One or two vessels, 120 sea-days each
- One or two drones
- Only core, core2 and N. coastal strata



Study area restricted to core, core2 and N. coastal strata.

Examples for main survey scheme 3





Examples for surveys in the core, core2 and N. coastal strata using a 500km equal spaced zigzag design.
The actual realised total transect length is ~31,000km (single vessel) or ~62,000km (two vessels).
Potential ports in green.

Conclusions

- If a decision is made not to use tuna vessels, the trial would only need to use one research vessel and one drone as vessel calibration would not be necessary.

- If the drones are not (or cannot be) used, then objective 2 (*absolute* abundance) may need to be dropped.

- If the survey were to follow immediately after the trial, a less ambitious (and shorter) trial would have to be implemented, mostly limited to ensuring that the drones are performing as required. In this case, a decision not to use tuna vessels should be made, as the trial could not deliver adequate precision to calibrate a tuna vessel against a research vessel, if there is evidence of different biases. Consequently, the trials would take place outside of the historical survey season (end July – early December).

- Limiting the drones to the trials would be unsatisfactory because, if probability of detection on the line can be well below one for schools of the priority species, it is likely that it will vary by location, as animals respond differently in different parts of the ETP. Further, estimation of this probability from a limited trial will add substantial imprecision to an abundance estimate. Hence the drone(s) should operate for both the trial and the main survey.

- If the trials indicate that g(0) is at or very close to 1, there is less need for drones in the main survey.

Timeline for finalizing survey design

- Draft survey design document, including survey budget, available for comment in early June 2018.
- Draft document will undergo external review.
- Revised survey design document, including budget, will be presented at the IATTC Annual Meeting in August 2018.

References

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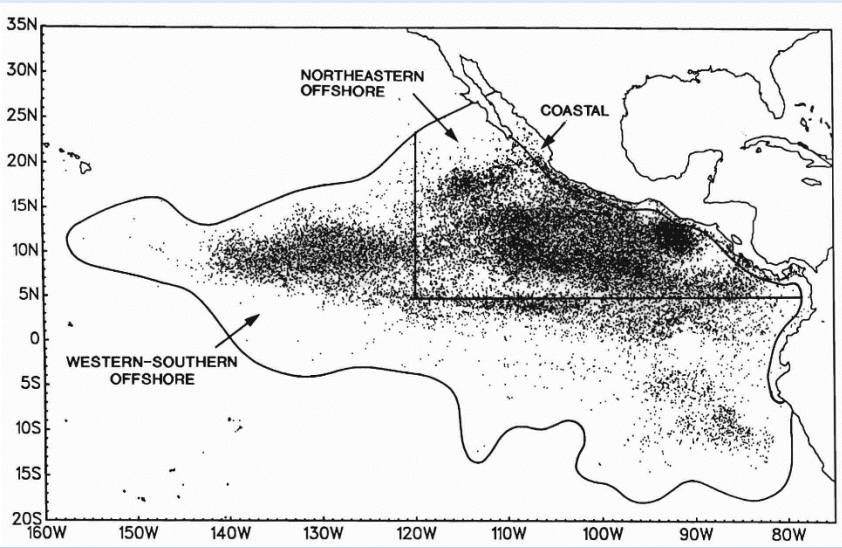
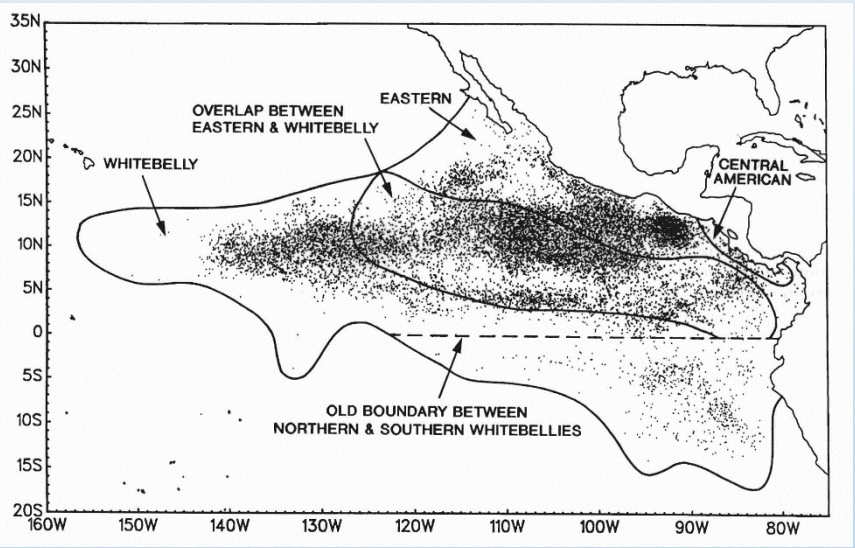
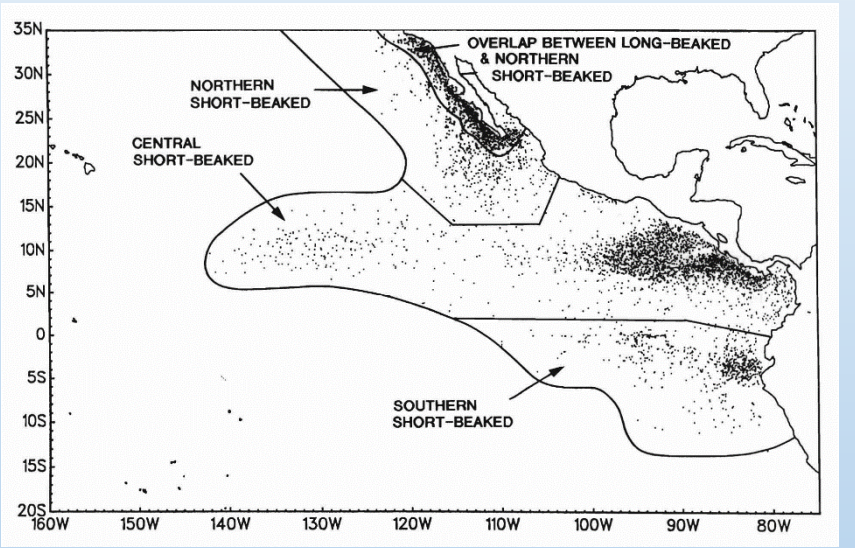
ETP dolphins: stock boundaries







Dizon et al. 1994